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**THIRD FIVE-YEAR REVIEW
FOR THE
SOUTH CAVALCADE STREET SUPERFUND SITE
HOUSTON, HARRIS COUNTY, TEXAS**



September 2012

Prepared by:
REGION 6
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
1445 Ross Avenue
Dallas, TX 75202-2733



677428

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FIVE YEAR REVIEW
South Cavalcade Street Site
EPA ID# TXD980810386
Houston, Harris County, Texas

This memorandum documents EPA's summary of the findings, actions needed, and determinations for the South Cavalcade Street Site's (Site's) Third Five-Year review.

Summary of Five-Year Review Findings

The concrete caps in the southeastern and southwestern areas are in good condition and ensure that there is no current or future exposure to the encapsulated contaminated soils. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. A vertical offset in the driveway adjacent to the southwestern cap was noted as in the previous Five-Year Reviews. The integrity of the cap does not appear to be impacted by this and no indications of settling were observed.

The Dense Non-Aqueous Phase Liquid (DNAPL) collection and ground water treatment systems operated as intended until April 2006, when the system became inoperative as a result of a lightning associated power surge that damaged the system controller. Since then, DNAPL recovery has been completed in a passive mode (i.e., without groundwater pumping) via manual pumping of DNAPL from the collection wells. The plans for the system will be determined once the remedial alternative is selected as part of the Focused Feasibility Study underway and will be documented in a ROD Amendment.

Reasonable interpretation of the existing ground water data indicates the continued presence of DNAPL and ground water plume off-site at the southwestern corner and southern boundary, which is consistent with the 1988 Record of Decision (ROD) and the previous Five-Year Reviews. Groundwater monitoring of the shallow zone and intermediate zone wells conducted during March 2011 show that natural attenuation is occurring and the plumes are stable or are decreasing. Annual monitoring is to be conducted for all constituents specified in the ROD. A Risk Assessment is being conducted to ensure that all exposure pathways are being considered and that the remedy will remain protective into the future. Institutional controls such as Administrative Order on Consent restrictions ensure that future use of the Site remains nonresidential and prohibit on-site groundwater use. However, this restriction on the use of on-site groundwater does not apply to off-site groundwater use. Current information shows that shallow groundwater is not currently being used in the vicinity of the Site and deeper groundwater has not been impacted by Site-related constituents. The City of Houston continues to provide drinking water on-site and to neighboring residences and there are no domestic water wells in the immediate vicinity of the Site.

Land use immediately adjacent to the Site at the western boundary is subject to change in the future. The Harris County Toll Road Authority (HCTRA) plans to extend the Hardy Toll Road along the rail right-of-way along the western boundary of the South Cavalcade Street Site and expand Collingsworth Street along the southern boundary of the Site. Workers may have a short term exposure to DNAPL and the ground water plume at certain points along the boundary during construction. In addition precautions must be taken during construction to ensure that pathways of migration to deeper zones will not be created.

Actions Needed

Property owners are to inspect and maintain joint systems and repair cracks and joint systems and remove shallow rooted vegetation as required. Beazer is responsible for continuing annual cap inspections.

The current landowners are to be contacted and it must be ensured that the Administrative Order on Consent (AOC) restrictions are still effective Institutional Controls (ICs).

Beazer, the Responsible Party, and EPA, and Texas Commission on Environmental Quality (TCEQ) are evaluating alternatives for the remedial action for ground water. The alternative remedy selected will be documented in a ROD amendment. Annual groundwater monitoring needs to be conducted and samples are to be analyzed for all the constituents specified in the ROD. The Maximum Contaminant Levels (MCLs) for arsenic and lead have decreased since the issuance of the ROD. Sufficient institutional controls to prevent off-site use of contaminated groundwater must be implemented.

EPA will continue discussions and coordination with Harris County Toll Road Authority (HCTRA) and City of Houston to ensure that protective measures are in place during the Toll Road and Collingsworth Street construction to provide for worker safety and to further prevent the inadvertent vertical migration of DNAPL to deeper zones.

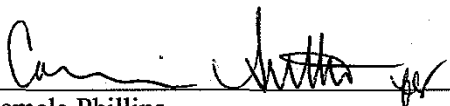
It is to be ensured that the plat and survey of the impacted area and cap are available to the public. The monitoring wells need to be repaired.

Determinations

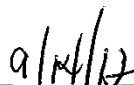
I have determined that the remedy for the overall South Cavalcade Superfund Site is protective of human health and the environment for the short term.

The soil remedial actions implemented at the Site are protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. The concrete cap ensures current and future protection of human health and the environment.












The groundwater remedy is protective in the short term but future protectiveness depends on the implementation of institutional controls to prohibit use of off-site contaminated groundwater. Because the completed remedial actions and monitoring program for the South Cavalcade site are considered protective for the short term, the remedy for the Site is protective of human health and the environment and will continue to be protective if the issues identified in this report are addressed.



Pamela Phillips
Acting Director
Superfund Division
U.S. Environmental Protection Agency Region 6



Date

Routing and Concurrence Slip		Begin Routing Date: 08/30/2012																									
		Routing Status: Normal 																									
To: (Name, office symbol, route number, building, Agency/Post		Initials	Date																								
1.  Raji Josiam		RJ	09/11/2012																								
2.  Carlos Sanchez		CS	08/31/2012																								
3.  Charles Faultry /s Carlos Sanchez  Stephanie Delgado		CS	08/31/2012																								
4.  Dyiann Twine		DT	08/31/2012																								
5.  Gloria-Small Moran		GM	09/10/2012																								
6.  Mark Peycke		MP	09/12/2012																								
7.  Dyiann Twine		DT	09/12/2012																								
8.  Deborah Greenwell		DG	09/13/2012																								
9.  Connie Suttice for Pam Phillips		CA	9/14/12																								
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Tracking Category:		<input type="checkbox"/> Five-Year Review																									
Enforcement Confidential:		<input type="radio"/> Yes <input checked="" type="radio"/> No																									
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Remarks: Note that the Five Year Review needs to be signed by 9-24-12 (statutory date). The five year review includes the TCEC Site Attorney, Risk Assessor, and HQ comments. Begin routing - 8-30-12																											

9-11-12: NOTE that Gloria Moran was unable to make changes but had commented on changes and had requested Raji Josiam to make changes; those changes have been incorporated into document.

9-12-12: One extra word "in" removed from page 6 based on Mark Peycke's comment

From: (Name, org, symbol, Agency/Post)

Raji Josiam

Room No./Bldg: 6SF-RA

Phone Number: 214.665.8529

**Choose EDIT document and turn on Track changes in WORD.
Remember to SAVE the Word Document before exiting Word.
Then Click on Save & Exit or Save and Route Next.
Otherwise your changes will not be saved.**

**For Signature :
Choose EDIT document**



- SCavalcade Third FYR Text - Routed for Concurrence.docx

**Inquiry/Supporting
Documents:**



- SCavalcade Third FYR - Pages 1-6 from figures tables attachments.pdf



- SCavalcade Third FYR - Pages 7-11 from figures tables attachments.pdf



- SCavalcade Third FYR - Pages 12-15 from figures tables attachments.pdf



- SCavalcade Third FYR - Pages 16-60 from figures tables attachments.pdf

Final Document(s):

**DO NOT ATTACH DOCUMENTS BELOW HERE!
USE THE ATTACH DOCUMENT BUTTON!**

Executive Summary

The Third Five-Year Review of the South Cavalcade Street Superfund Site (Site) located in Houston, Harris County, Texas was completed in June 2012. The Second Five-Year Review dated September 2007 indicated that the remedy is expected to be protective of human health and the environment in the short term but indicated that additional information was necessary to ensure that the remedy was also protective into the future. Groundwater monitoring of the shallow zone and intermediate zone wells conducted during March 2011 show that natural attenuation is occurring and the plumes are stable or are decreasing. Based on this additional information, it is indicative that the remedy is protective of human health and the environment under current conditions and is expected to remain protective into the future if the issues identified in this review are addressed.

A wood treating plant operated at the Site from 1910 until 1962. Creosote and various metallic salts were used as the wood preservatives. A coal tar distillation plant was also operated on the Site from about 1944 until 1962. These operations resulted in the Site soils and groundwater being contaminated with polynuclear aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene and xylene (BTEX), and metals in both media. The original Record of Decision (ROD), signed September 26, 1988, addressed both groundwater and soil contamination. Contaminants of concern included potentially carcinogenic PAHs, BTEX, and metals in both media.

For groundwater remediation, the ROD required the extraction and treatment of contaminated groundwater, including the recovery and treatment of a Dense Non-Aqueous Phase Liquid (DNAPL). Extraction would continue to decrease contaminant levels to the maximum extent possible, and at that point, collection would cease and any remaining contamination would be allowed to naturally attenuate to background levels. The ROD also made allowances to consider in-situ biological treatment to meet remedial goals. Based on the U.S. Environmental Protection Agency Memorandum “Superfund Groundwater RODs: Implementing Change This Fiscal Year” (EPA, 1995b) dated July 31, 1995, the U.S. Environmental Protection Agency (EPA) and Beazer East Inc. (Beazer), the responsible party (RP), agreed to reconsider groundwater remedial goals outlined in the ROD, including options such as natural attenuation, or a Technical Impracticability (TI) waiver. In accordance with this agreement between EPA and Beazer, groundwater collection and treatment were delayed pending determination by EPA whether the groundwater remedial goals specified in the ROD are potentially inapplicable and a TI waiver appropriate. However, the enhanced DNAPL recovery component of the groundwater remedy was placed into operation, which included some groundwater extraction and treatment. In a Memorandum “Clarification of OSWER’s 1995 Technical Impracticability Waiver Policy” (OSWER Directive #9355.5-32 dated September 19, 2011 EPA, 2011) indicated that even when Applicable or Relevant and Appropriate Requirements (ARARs) are waived at a Superfund site due to TI, pursuant to CERCLA Section 121(d)(4), the remedy must still be protective of human health and the environment. Hence the July 31, 1995 memorandum should no longer be considered when making current site decisions.

The enhanced DNAPL recovery system was placed into service in early 1996.. The recovery system operated until April 2006 when the system became inoperative as a result of a lightning related power surge that damaged the system controller. Since April 2006 DNAPL recovery has continued in passive mode (i.e., without groundwater pumping) via manual pumping of DNAPL

from the collection wells. The plans for the system will be determined once the remedial alternative is selected as part of the Focused Feasibility Study underway as addressed below. As of the First Five-Year Review, a total of 2,800 gallons of DNAPL had been recovered. As of April 2006, a total of 3,886 gallons of DNAPL had been recovered. As of December 2011 a total of 4,021 gallons of DNAPL have been recovered.

Beazer submitted to the EPA and the Texas Commission on Environmental Quality (TCEQ) the Final Focused Feasibility Study (FFS) in April 2011. In the report Beazer addresses four groundwater remedial alternatives to an anticipated ROD Amendment that include No Further Action, Monitored Natural Attenuation (MNA) with No Further Action for Source Zone, MNA with Continued Source Removal, and In-Situ Solidification. The report recommends MNA with No Further Action for Source Zone as the preferred alternative for the Site. The report has been reviewed and discussed by EPA, TCEQ, Beazer and Key Environmental and is in the process of further being revised by Beazer. The change to the groundwater remedy will be formalized in a ROD Amendment or Explanation of Significant Difference expected to occur in 2013.

The groundwater remedy is considered protective of human health because no complete groundwater exposure pathways exist under current conditions and are not expected to exist in the future. As indicated in the 1988 ROD, the City of Houston supplies drinking water to the businesses on-site, the surrounding businesses, and residences to the west through the city's public water supply system. Based on current groundwater use information, there are no indications that private wells are in use down-gradient of the Site.

For soil remediation, the ROD originally specified soil washing and soil flushing to attain a risk-based goal of 700 parts per million for potentially carcinogenic polynuclear aromatic hydrocarbons (PAHs). After a pilot study indicated that the remedial goals could not be achieved via the selected remedy, the EPA Regional Administrator signed an Amended ROD (July 26, 1997) to allow for a remedy to seal and contain soils under a six-inch reinforced concrete cap.

The cap was designed to prevent direct contact exposure to soils, to reduce infiltration and hence reduce loading of dissolved phase constituents to groundwater, and also to serve as a parking area for businesses located at the Facility. Construction of the cap was completed in July 2000. Annual cap inspections have been conducted since November 2001. The past and current inspections have confirmed that the caps in the southeast and southwest portions of the Site are in good condition, that effective operation and maintenance procedures are in place, and that the soil remedy continues to be effective.

The remediation implemented for soils at the Site as set forth in the 1997 Amended ROD has been implemented as planned. The capped areas have been inspected on an annual basis, have been maintained as necessary, and continue to be protective of human health and the environment. In summary, the remedial action for soils at the Site continues to be protective of human health and the environment. The groundwater remedy is protective in the short term and will remain protective in the future if institutional controls are implemented to prohibit use of off-site contaminated groundwater.

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List of Acronyms

AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
BAT	Best Available Technology
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
cPAH	Potentially Carcinogenic Polynuclear Aromatic Hydrocarbons
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
FEMA	Federal Emergency Management Agency
FFS	Focused Feasibility Study
FS	Feasibility Study
FTS	Field & Technical Services, LLC
GESPMP	Groundwater Extraction System Performance Monitoring Plan
GPCT	Groundwater Pilot Collection Trench
GFTR	Ground Water Fate and Transport Evaluation Report
GRAA	Groundwater Remedial Action Area
GWPTP	Ground Water Pilot Treatment Plant
GWTP	Ground Water Treatment Plant
HASP	Health and Safety Plan
HCTRA	Harris County Toll Road Authority
HGSD	Houston-Galveston Subsidence District
HHRA	Human Health Risk Assessment
IC	Institutional Control
LDR	Land Disposal Restrictions
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
MNA	Monitored Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NPDES	National Pollutant Discharge Elimination System
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbon
PCOR	Preliminary Close Out Report
PDSA	Potential DNAPL Source Area
RA	Remedial Action
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design

List of Acronyms

RDWP	Remedial Design Work Plan
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RP	Responsible Party
SARA	Superfund Amendment and Reauthorization Act
SDWA	Safe Drinking Water Act
TBC	To Be Considered
TCEQ	Texas Commission on Environmental Quality (previously known as TNRCC)
TDWR	Texas Department of Water Resources
TI	Technical Impracticability
TNRCC	Texas Natural Resource Conservation Commission (now known as TCEQ)
TSWQS	Texas Surface Water Quality Standards
USACE	U.S. Army Corps of Engineers

Five Year Review Summary Form		
SITE IDENTIFICATION		
Site name (from WasteLAN): South Cavalcade Street Superfund Site		
EPA ID (from WasteLAN): TXD980810386		
Region: EPA Region 6	State: Texas	City/County: Houston/Harris County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Complete		
Multiple OUs? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	Construction completion date: September 15, 2000	
Has site been put into reuse? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
REVIEW STATUS		
Lead agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency		
Author name: EPA Region 6, with support from USACE Tulsa District		
Review period: March 19, 2012 to June 8, 2012		
Date(s) of site inspection: May 16, 2012		
Type of review: <input checked="" type="checkbox"/> Statutory <input type="checkbox"/> Policy <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion		
Review number: <input type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input checked="" type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify)		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction <input type="checkbox"/> Actual RA Start <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): September 24, 2007		
Due date (five years after triggering action date): September 24, 2012		
Issues: 1. Shallow rooted vegetation observed in the expansion joints along the eastern edge in the Southeast area. 2. The owner of the Northern Area is unknown and needs to be determined to ensure that the AOC is still effective for institutional controls. 3. Ground water collection and DNAPL recovery system may no longer be the best remedial alternative. 4. There is no groundwater monitoring plan being implemented and the groundwater		

Five Year Review Summary Form

monitoring is insufficient.

5. The groundwater monitoring has not been including all the groundwater constituents with remedial goals specified in the ROD. The Groundwater Extraction System Performance Monitoring Plan (GESPMP) called for analyzing these constituents in groundwater monitoring at the Site.

6. There are insufficient institutional controls preventing the installation of wells which could result in the use of the off-site contaminated groundwater.

7. The Toll Road extension and Collingsworth Street expansion may impact the Site since construction may result in the creation of conduits and preferential pathways for migration of DNAPL to deeper aquifers, unless precautionary measures are taken.

8. The groundwater remedial goals for arsenic and lead were based on the MCLs of these constituents at the time of the ROD. The MCLs have decreased since the issuance of the ROD, and the remedial goals are now above the MCLs.

9. Unable to locate in public records the plat and survey of the impacted area and cap.

10. Monitoring wells are in need of repair.

Recommendations and Follow-up Actions:

Recommended further actions include continuing site operations, and maintenance as currently defined. In addition, the following actions are recommended.

1. The property owners should inspect and maintain joint systems and repair cracks and joint systems as required. Beazer is responsible for continuing annual cap inspections.

2. A Title Search is to be conducted to determine the current owners. Conduct a record search and discuss with current landowners the AOC and ensure the landowners are aware of the ICs and that the ICs are being implemented.

3. Evaluation of the FFS supporting Monitored Natural Attenuation as an alternative remedial action for ground water is to be continued. As part of this re-examination of remedial options and objectives, ground water monitoring requirements and extraction to contain the dissolved plume should also be evaluated and reinstated as appropriate. It must also be continued to be demonstrated that the DNAPL and plume are not migrating vertically and horizontally.

4. A groundwater monitoring plan should be developed and monitoring reinstated without waiting for the development and implementation of the revised groundwater remedy. Annual monitoring should be conducted as specified in the GESPMP until a new monitoring system is identified and a new monitoring frequency is established as part of the ROD Amendment.

5. Groundwater samples should be analyzed for all the groundwater constituents in which the ROD specified remedial goals, and the results should be included in groundwater monitoring reports.

6. Institutional controls prohibiting off-site use of the groundwater in the area of the contaminant plume should be drafted, filed, and implemented.

7. Continued discussions are to be held with the Harris County Toll Road Authority (HCTRA) and the City of Houston concerning potential Site impacts of the expansion to be considered. Worker health and safety should be considered for those areas where short-term contact with ground water contamination is anticipated. Precautions should also be taken during construction to prevent the creation of conduits and preferential pathways for

Five Year Review Summary Form

migration of DNAPL to deeper aquifers.

8. MCLs for arsenic and lead have changed and institutional controls must be implemented prohibiting use of groundwater in the plume area. Consideration should be given to revising the groundwater remedial goals for arsenic and lead based on the changes in the MCLs that the goals were based on.

9. Ensure the plat and survey of the impacted area and cap are located and are part of the Administrative Record and entered into county land records.

10. All wells should be inspected to evaluate their condition. The wells should have caps, locking protective casing lids, labels, and sound well pads. Lost wells should be located, and damaged and inoperable wells should be evaluated for usefulness and either plugged and abandoned or replaced.

Protectiveness Statement(s):

The remedy for the overall South Cavalcade Superfund Site is protective of human health and the environment for the short term.

The soil remedial actions implemented at the Site are protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated.

The groundwater remedy is protective in the short term but future protectiveness depends on the implementation of institutional controls to prohibit use of off-site contaminated groundwater. Institutional controls such as the Administrative Order on Consent restrictions ensure that future use of the Site remains nonresidential and prohibit on-site groundwater use. Current information shows that shallow and intermediate groundwater are not currently being used downgradient in the vicinity of the Site and deeper groundwater has not been impacted by Site-related constituents.

South Cavalcade Street Superfund Site Third Five-Year Review Report

The U.S. Environmental Protection Agency (EPA) Region 6 has conducted the Third Five-Year Review of the remedial action implemented at the South Cavalcade Street Superfund Site located in Houston, Harris County, Texas (Figure 1). This review is for the period September 25, 2007 to September 25, 2012. Beazer, the Responsible Party (RP) for remedial action at the South Cavalcade Street Site, provided information for this period. This information has been verified and incorporated into this report by EPA.

For purposes of this report, the phrase “five-year review” will apply to all remedial actions which have taken place since September 24, 2007, to September 24, 2012. The purpose of a five-year review is to determine whether the remedy at a site is protective of human health and the environment. This report documents the results of the review for this Site.

1 Introduction

Five-year reviews for the South Cavalcade Street Superfund Site are required by statute. Statutory reviews are required for sites where, after remedial actions are complete, hazardous substances, pollutants, or contaminants will remain on-site at levels that will not allow for unrestricted use or unrestricted exposure. This requirement is set forth by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Statutory reviews are required only if the ROD was signed on or after the effective date of the Superfund Amendments and Reauthorization Act of 1986 (SARA). CERCLA §121(c), as amended by SARA, states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

The NCP Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

If a remedial action is selected that results in hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This is the Third Five-Year Review for the South Cavalcade Street Superfund Site. The triggering action for this review is the completion of the Second Five-Year Review in September 2007. As previously indicated, a five year review is required when hazardous substances, pollutants or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure, as is the case for this Site.

2 Site Chronology

A chronology of significant Site events is included in Table 1, provided at the end of the report.

3 Background

3.1 Physical Characteristics

The South Cavalcade Street Superfund Site occupies approximately 66 acres of land located approximately three miles north of downtown Houston, Texas and about one mile southwest of the intersection of Interstate Loop 610 and U.S. Highway 59. It is bounded by Cavalcade Street to the north, Collingsworth Street to the south, and the Missouri and Pacific Railroads to the east and west. The Site is rectangular in shape with a length of approximately 3,400 feet (in the north-south direction) and a width of approximately 900 feet (in the east-west direction). A South Cavalcade Street Superfund Site base map is provided as Figure 1. An aerial view of the Site is shown in Figure 2.

Topography and Surface Hydrology

The “Site” is generally flat. It is drained by two stormwater drainage ditches which flank the “Site” on the east and west sides, and drain water into a flood control ditch which discharges into Hunting Bayou, a tributary of the Houston Ship Channel (EPA, 1988). The “Site” is located above the 100-year and 500-year floodplain boundaries, as defined by the Federal Emergency Management Agency (FEMA) (Keystone, 1988a).

The following descriptions of the geology, hydrostratigraphy and groundwater flow were excerpted and summarized from the FFS (Key, 2011).

Regional Geology and Hydrostratigraphy

The South Cavalcade Site is situated on the quaternary Gulf Coast Plain of Texas which is comprised of sediments deposited in environments ranging from fluvial-deltaic to shallow marine. These strata are discontinuous and of varying grain size, due to ongoing subsidence and sea level changes over the depositional period.

The correlation of geologic units and hydrostratigraphy within the Gulf Coast Plain is shown in Figure 5. The uppermost hydrostratigraphic unit is the Chicot Aquifer. This unit includes the following progression of geologic units, from the top down: surficial alluvium, Beaumont Clay, Lissie Formation, and Willis Sand. The hydrostratigraphic units underlying the Chicot Aquifer are the Evangeline Aquifer, the Burkenville Confining System, the Jasper Aquifer, and the Catahoula Confining System.

The Gulf Coast Plain hydrostratigraphic units have considerable thickness. The maximum thickness of the Chicot, Evangeline, and Jasper Aquifers is 1,200, 2,800 and 3,200 feet, respectively. The Burkeville confining system is up to 1,600 feet thick in the southern part of the Gulf Coast. The zone of interest at the South Cavalcade Site is the uppermost section of the Chicot Aquifer.

Site Geology and Hydrostratigraphy

Borehole information from investigations at the Site extends to depths of approximately 200 feet. Three water-bearing units are identified within this depth range, based on predominance of coarse grain sizes (e.g., sand or gravel). These units are referred to as the Shallow, Intermediate and Deep Zones. The Shallow and Intermediate Zones and the intervening aquitard are shown in cross-sections A-A' through C-C' provided as Figures 6, 7, and 8, respectively. On these figures, a stipple pattern indicates material dominated by coarse grain sizes. Sand is shown as red stipple and gravel as orange. The stipple pattern is overlain by various hatch marks to denote the secondary presence of clay or silt.

The bottom of the Shallow Zone typically occurs at between 18 to 21 feet below grade. As shown on the cross-sections, the Shallow Zone sand is thinner in the Southern Area of the Site than it is in the Northern Area, and pinches out completely in some off-Site areas to the west and southwest. In the Northern Area, the Shallow Zone extends up to near the ground surface, although the upper portion is unsaturated. In the Southern Area, the Shallow Zone (where it is present) is typically overlain by a fine-grained layer dominated by clay.

The Shallow Zone is immediately underlain by a continuous fine-grained layer consisting of materials ranging from clay to sandy clay. This layer is known as the Intermediate Aquitard and is typically 30 feet thick and extends from between 40 to 50 feet below grade. The bottom of the Shallow Zone is interpreted as the contact between the Beaumont and Lissie Formations, with the latter extending beyond the depth of investigation.

The average vertical hydraulic conductivity of the Intermediate Aquitard is 3×10^{-8} cm/sec, as estimated from 12 laboratory tests conducted during the 1988 Remedial Investigation (RI) (Keystone, 1988b). This value is approximately five orders of magnitude lower than Shallow Zone conductivity, indicating that the Intermediate Aquitard is a significant basal confining unit. Secondary features such as "slickensides" and sandy or silty seams were noted within the upper portion of the Intermediate Aquitard, and they may increase the overall permeability of the unit. Nevertheless, the absence of Shallow Zone drawdown during pumping tests in the Intermediate Zone indicates that the Intermediate Aquitard is an effective hydraulic barrier for groundwater flow between the Shallow and Intermediate Zones.

In the RI Report, the entire thickness of material from the bottom of the Shallow Zone (approximately 20 feet below grade) to a depth of 115 feet was classified as an aquitard. In the 100% Design Report, however, this unit was re-classified as an upper and lower aquitard, with an intervening aquifer identified as the Intermediate Zone. This unit is discontinuous across the Site. Where it occurs, it is situated between the two aquitards, as shown in Figures 6, 7 and 8.

The Intermediate Zone is highly variable in thickness and it is absent across most of the Northern Area of the Site. The maximum thickness of approximately 14 feet occurs in two disconnected lenses in the central area of the Site. Across much of the Southern Area, the Intermediate Zone is either absent or less than three feet thick. The aquitard underlying the Intermediate Zone is laterally continuous across the Site. It has a minimum thickness of approximately 40 feet, and typically extends to approximately 115 feet below grade.

Pumping tests conducted for the Extraction Well Pilot Study (Keystone, 1992) indicate that the hydraulic conductivity of the Intermediate Zone was similar in the Northern and Southern Areas of the Site: 3.9×10^{-4} and 3.2×10^{-4} cm/sec, respectively. These values are approximately one order of magnitude less than those estimated for the Shallow Zone. The conductivity of the aquitard underlying the Intermediate Zone is expected to be similar to that of the Intermediate Aquitard (i.e., approximately 3×10^{-8} cm/sec). Consequently, both the top and the bottom of the Intermediate Zone are highly confined.

Groundwater Flow

The Shallow Zone water table occurs within a few feet below grade. A piezometric surface contour map of a recent Shallow Zone water level dataset is shown in Figure 9; these results are typical of historical data. The figure also summarizes the direction and magnitude of the water table gradient over the past several years. As indicated, the gradient direction is relatively consistent over time. Groundwater flow in the Northern Area is westerly, and the average direction is almost due west. In the Southern Area of the Site, groundwater flows southwesterly with some directional variability.

Groundwater flow in the Intermediate Zone is generally westerly, similar to the Shallow Zone. A piezometric surface contour map for a recent data set from the Intermediate Zone is shown in Figure 10. It is expected, however, that the lateral discontinuity of the Intermediate Zone causes some deformation of groundwater flow paths around areas where the unit is absent.

A downward vertical hydraulic gradient has been measured between the Shallow and Intermediate Zones, with potentiometric levels approximately 10 feet lower in the Intermediate zone. The large differential in potentiometric surface elevations between the shallow and intermediate zones is indicative of limited hydraulic connection between the two units. Given the typical thickness of the intervening Intermediate Aquitard (30 ft), the estimated hydraulic gradient across this unit is 0.33. Given the estimated average hydraulic conductivity of this unit (3×10^{-8} cm/sec) and an assumed effective porosity of 0.25, the groundwater seepage velocity across the Intermediate Aquitard is estimated to be 0.042 ft/yr (0.013 m/yr).

Soil borings installed during the Remedial Investigation revealed a predominantly clay matrix beneath the intermediate zone (i.e., SCK-DW01/DW02). The thickness of this unit was estimated to be 126 feet. The presence of constituents in this clay unit was evaluated during the RI. This evaluation showed that the clay unit is effective in attenuating the vertical migration of constituents. As shown on Page 7-44 of the RI Report, constituent attenuation was achieved at depths ranging from 30.5 to 70 feet below ground surface. The average depth of attenuation was determined to be 58 feet below ground surface. These data demonstrate that vertical migration of constituents to deeper water bearing zones has not occurred and is unlikely to occur in the future.

3.2 Land and Resource Use

Land use in the vicinity of the Site is a mixture of commercial, industrial, and residential properties. Industrial and commercial properties are located to the east and across Collingsworth Street to the south. Active rail lines immediately border the Site boundaries to the east and the west. The North Cavalcade Street Superfund Site is located directly north of the South Cavalcade Site, separated by Cavalcade Street. A residential area is located to the west of the Site, and

continues to the south, north, and west. In the residential block immediately west of the northern area, most of the houses have been removed, and the area is now vacant.

EPA does not anticipate population growth in those areas surrounding the Site because this area of Houston is “built out,” indicating that growth has probably peaked. Access from two major freeways, Interstate Highway 610 and U.S. Highway 59, makes this property ideal for continued trucking terminal operations. The Site’s location within an existing industrial corridor, bordered by railroad tracks and other businesses, most likely will ensure that the Site will remain industrial. The railroad tracks west of the Site are being planned to be relocated to the east of the site. The Harris County Toll Road Authority (HCTRA) has also proposed an extension to the Hardy Toll Road, to be built along the rail right-of-way adjacent to the western boundaries of the South and North Cavalcade Street Superfund Sites. The Toll Road, if constructed as planned, will further separate these industrial properties from the neighborhood to the west.

The northern portion of the Site was formerly occupied by a trucking firm, but is currently vacant. The southern portion of the Site is currently occupied by two trucking firms; thus, much of the ground surface, especially in the southern and northern portions of the Site, is covered by concrete or asphalt pavement, or buildings, as shown in Figures 2 and 3. The central portion of the Site has remained largely undeveloped, however, one of the trucking firms expanded operations and added another warehouse in 2001. A groundwater treatment facility is located along the eastern Site boundary in the central portion of the Site. The concrete caps, covering two areas of contaminated soils in the southeast and southwest portions of the Site were designed for soil containment and for truck parking (Figure 3). Access is limited by perimeter fencing and is further enforced by 24-hour security.

Continued future use of the Site properties for non-residential purposes is expected. Institutional controls to discourage residential land use were provided in the January 24, 1992 Administrative Order on Consent with the owners of the “Site”, In the Matter of Rex King and Marilyn Lee King, Palletized Trucking, Inc., Baptist Foundation of Texas, Merchants Fast Motor Lines, Inc., and Trucking Properties, Inc., CERCLA 6-08-92 (AOC). Under the AOC, the landowners were required to file a notice in the land records of Harris County, within 60 days of the effective date, to subsequent purchasers that “hazardous substances were disposed of and will continue to remain in both the soils and ground water at the Site.” The ROD Amendment (EPA, 1997) confirms that these deed notices have been placed on file. Language was also included that “development of the Site for residential use is inappropriate due to the continuing presence of hazardous substances at the Site.” In addition, the AOC provided that the notice and future land transactions must include a copy of the AOC and the March 14, 1991 Consent Decree with Beazer, Civil Action No. H – 90-2406, United States of America vs. Beazer East, Inc. (Consent Decree). The responsibility to provide appropriate notice to future purchasers rests with the landowners and penalties for failure to do so are stipulated in the AOC. The consent agreements between EPA and the respective property owners also prohibit on-site groundwater use.

3.3 History of Contamination

The wood preserving facility consisted of an operations area, a drip track, and treated and untreated wood storage areas. The operations area included wood treating cylinders, chemical storage tanks, and a wastewater lagoon. This area is located in the southwestern part of the Site,

along what is now Collingsworth Street. Creosote and metallic salts were used in the operation. The drip track ran diagonally from the operations area to the northeast and ended before the central portion of the Site. The coal tar plant was located in the southeastern part of the Site.

National Lumber and Creosoting Company acquired legal title to the Site in 1910 and constructed and operated a wood preserving facility there until the property was acquired in 1938 by the Wood Preserving Corporation, a subsidiary of Koppers Company. In 1940, the Wood Preserving Corporation became a part of Koppers Company. Koppers Company, Inc. (Koppers), now known as Beazer East, Inc., operated the wood treating facility from 1940 until closure in 1962. A coal tar distillation plant was constructed by Koppers on the southeastern portion of the Site in 1944 and continued in operation until 1962, at which time the property was sold to Merchants Fast Motor Lines. The Site was later subdivided and sold to the five landowners, the parties to the 1992 Administrative Order. In 1995, one of the parties, the Baptist Foundation of Texas sold its 22 acres (of the 66 acre South Cavalcade Street Superfund Site) to Nations Way Transport Service, Inc. (Nations Way).

3.4 Initial Response

In 1983, the Houston Metropolitan Transit Authority investigated the Site for potential use in the municipal mass transit system and found evidence of creosote in the subsurface. The Site was referred to the Texas Department of Water Resources (TDWR), which conducted further investigations and determined that the Site could pose a threat to human health and the environment. In April 1984, TDWR recommended to EPA that the Site be placed on the National Priorities List (NPL). EPA proposed that the South Cavalcade Street Site be added to the NPL on October 15, 1984 (49 Federal Register 40320), and added the Site to the final list on June 10, 1986 (49 Federal Register 21054).

In March 1985, Koppers entered into an Administrative Order on Consent (AOC) with EPA to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS was completed by Koppers in August 1988 with submittal of the *Remedial Investigation Report* and the *Feasibility Study Report* to EPA. The RI identified two primary areas of potential creosote impact in the surficial soil, defined as soil in the interval from the ground surface to a depth of six feet: one area in the southern portion, corresponding to the former locations of the coal tar plant and wood treating operations; and one in the northern portion, corresponding to a pond observed in a 1964 aerial photograph of the Site. Total surficial soil PAHs ranged from below detection levels to 8567 mg/kg. Contaminants of concern released to soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Copper, chromium, arsenic, zinc, and lead were also present at concentrations exceeding background levels.

The RI also indicated that PAHs, from below detection limits to observed non-aqueous phase creosote at several wells, were present in the shallow aquifer underlying the Site, at 6 to 10 feet below the surface to a depth of about 22 feet. Metals, including arsenic, chromium, copper, lead, zinc, and aromatic volatile organics, specifically benzene, toluene, ethylbenzene, and xylene, were also detected. Contaminants appear to be confined to the Shallow and Intermediate Zones. PAHs were not detected in the deeper aquifer, located at depths 175-205 feet below surface. Beazer has been sampling two deeper monitoring wells (at depths of 220 and 530 feet) in the vicinity of the

Site annually since 1993. The deeper well, LCW-01, is obstructed and has not been sampled since 1996. The results of these sampling and analysis activities have confirmed that deeper groundwater has not been impacted by Site-related activities.

The deeper aquifer is potentially useable as a public water supply source, on-site and neighboring residents are all served by the City water supply which originates from a deeper aquifer 10 miles from the Site, or from a surface water reservoir located over 20 miles from the Site. In addition, the Houston-Galveston Subsidence District (HGSD) requires notification and permits for the drilling of new groundwater wells, discouraging the use of private wells in those areas adequately served by the City of Houston municipal water supply system. An evaluation of groundwater use in the vicinity of the Site from the well information provided by HGSD was presented in the April 2011 FFS submitted by Beazer. The HGSD rules do not require permits for wells with a casing diameter of less than five inches that serve only a single-family dwelling. Hence as part of this Five Year Review an evaluation to the Texas Water Well data was conducted. The evaluations confirmed that there is no use of the shallow groundwater within a one-mile radius of the Site. There are a couple of intermediate zone wells domestic wells $\frac{3}{4}$ mile upgradient of the site.

3.5 Basis for Taking Action

Constituents that have been released at the Site for the various media of interest consist of the following:

Soil	Groundwater	Drainage Ditch	
		Water	Sediment
Arsenic	Arsenic	Arsenic	Arsenic
Chromium	Chromium	Copper	Chromium
Copper	Copper	Lead	Copper
Lead	Lead	Zinc	Lead
Zinc	Zinc		Zinc
Acenaphthene	Acenaphthene		Benzo(a)anthracene
Anthracene	Anthracene		Benzo(a)pyrene
Benzo(a)anthracene	Benzo(a)anthracene		Benzo(b)fluoranthene
Benzo(a)pyrene	Benzo(a)pyrene		Benzo(k)fluoranthene
Benzo(b)fluoranthene	Benzo(b)fluoranthene		Benzo(ghi)perylene
Benzo(k)fluoranthene	Benzo(k)fluoranthene		Chrysene
Benzo(ghi)perylene	Benzo(ghi)perylene		Fluoranthene
Chrysene	Chrysene		Indeno(1,2,3-cd)pyrene
Fluoranthene	Fluoranthene		Pyrene
Fluorene	Fluorene		
2-Methylnaphthalene	2-Methylnaphthalene		
Naphthalene	Naphthalene		
Phenanthrene	Phenanthrene		
Pyrene	Pyrene		
	Benzene		
	Toluene		
	Ethylbenzene		

Soil	Groundwater	Drainage Ditch	
		Water	Sediment
	Xylenes		

Investigation and remedial actions were taken as a result of the presence of potentially carcinogenic PAHs in soils, and potentially carcinogenic PAHs, volatile organic compounds, and metals in groundwater. Remedial goals were based on the assumption that the Site would remain in commercial use and that the aquifer to be remediated was not being used as a water supply, and was unlikely to be used for such purposes in the future as there are readily available water resources in the area.

Soil remedial goals were also based on consideration of potential further impact to groundwater as a result of constituent leaching from the surface and subsurface soils. Groundwater remedial goals to prevent the off-site migration of contaminants and to further reduce source areas provided for the extraction and treatment of groundwater and the collection of the DNAPL.

As described in the ROD, surface water and sediment samples were collected in drainage ditches on, and bordering, the Site. No PAHs were detected in surface water samples; several metals (arsenic, zinc, lead, iron, copper, and nickel) were detected. PAH components were detected in sediment samples, with concentrations ranging from 2.3 to 236 mg/kg. Higher concentrations were located in the southern end of the Site and were most likely attributable to the ongoing trucking activities in that area.

4 Remedial Actions

4.1 Remedy Selection (General)

The ROD for the South Cavalcade Street Superfund Site was signed by EPA on September 26, 1988. The ROD presented the selected remedial alternatives for Site surface and surficial soil, and groundwater. The ROD did not designate separate operable units for remediation of the Site.

The remedial action objectives for surface and surficial soil, and groundwater, as stated in the Feasibility Study Report, were as follows:

Surface (0-6 inches below ground surface) and Surficial Soil (0 to 6 feet below ground surface)

- Prevent continued migration to groundwater; and,
- Reduce risks to public health.

Groundwater

- Prevent the vertical migration of contaminants to lower groundwater zones or horizontal migration to off-site wells.

4.2 Soil Remedy Selection

The remedial goals for surface and surficial soils, as specified in the ROD, were 700 parts per

million (ppm) total potentially carcinogenic PAHs and no potential for leaching to groundwater. The remedial goals for soils were selected to protect against an additional risk of cancer from exposure to soils of greater than 1 in 100,000 (10^{-5}) for on-site commercial occupants and also ensure against any non-carcinogenic hazards. As stated in the ROD, the attainment of the remedial goals for soil would also assure that contaminants will not leach into the groundwater. A combination of soil washing and soil flushing was selected in the ROD as the most appropriate solution for remediating contaminated soils.

However, an August 1992 Keystone Environmental “Soil Delineation Report” prepared for Beazer concluded that the estimated soil quantity requiring remediation was significantly less than the ROD estimate. As a result, the report concluded that it would be more efficient and cost-effective to use one remediation technology rather than two. EPA agreed with the soil delineation proposal and granted Beazer approval to begin remedial design using only soil washing.

In 1993, during the remedial design phase, Beazer conducted a soil washing pilot study. However, the study concluded that soil washing would not provide overall protection of human health and the environment as forty percent of the soil volume could not be washed to meet the remedial goals. Consequently, there was no benefit to implement full scale operations. Therefore, Beazer stated that it did not believe contamination beneath the surface posed a realistic health risk and petitioned EPA to reconsider the reasonableness of any risk posed by such contamination.

EPA reassessed the original remedial goals to consider guidance published in OSWER Directive No. 9380.3FS in 1991 defining “principal threat” and concluded that the contamination on-site did not constitute a “principal threat” as the risk assessment did not identify any health risks from soil contaminations greater than 1 in 1000 (1×10^{-3}) (Keystone, 1988a).

Since the waste on Site was not considered a principal threat, the National Contingency Plan (NCP) 40 CFR § 300.430(a)(1)(iii)(B) allowed EPA to use “...engineering controls, such as containment, for waste that poses a relatively long term threat.” After review, EPA decided that as long as the contamination remained below the surface, it posed no unacceptable risk. As a result, on September 29, 1995, Beazer proposed permanently covering the contaminated areas with a concrete cap in lieu of the originally selected 1988 remedies.

An Amended ROD for the soil remedy was signed on June 27, 1997 to seal areas with reinforced concrete cover where surface contamination exceeded the ROD established soil cleanup goal. The remedial action objectives, as amended were (EPA, 1997):

- To cover areas where surface contamination exceeded the ROD established soil cleanup goal of 700 ppm total potentially carcinogenic polynuclear aromatic hydrocarbons (cPAH); and,
- To prevent against an excess lifetime increased cancer risk of 8×10^{-6} for likely on-site exposure to soil. The concrete cover would eliminate the risk to human health from direct exposure to surface soils.

The soil remedial action components were as follows:

- To provide field delineation of impacted soil;
- To construct a concrete cap to cover and contain impacted soils beneath at least six inches

of reinforced concrete designed to withstand the current and anticipated freight truck traffic;

- To provide a barrier preventing on-site commercial occupants from inadvertently ingesting, inhaling or directly contacting impacted soils;
- To provide a plat to show the exact location and dimensions of each impacted area with respect to permanently surveyed benchmarks. This survey and plat forms part of the institutional control used to alert future owners that impacted soil has been left on-site; and,
- To prepare and execute a post-closure plan that describes the maintenance activities that will be carried on after the impacted soils are covered.

4.3 Groundwater Remedy Selection

The selected remedial alternative for groundwater included extraction and treatment of groundwater containing constituent concentrations greater than the remedial goals specified in the ROD. The remedial goals, as specified in the ROD, were selected to comply with Federal drinking water standards, National Pollutant Discharge Elimination System (NPDES) Best Available Technology (BAT) requirements, and the Texas Water Quality Standards, or existing background levels. The remedial level for potentially carcinogenic PAHs was selected to assure that, in conjunction with other contaminants, the overall risk to potential consumers of groundwater would be less than 10^{-4} . Remedial goals were developed for copper and zinc based on the principle of keeping the hazard index less than 1. Target remedial goals were established for selected contaminants in groundwater and are given in the table below.

Contaminant	Remedial Goal (µg/L)
Carcinogenic PAHs	No detection
Benzene	5
Ethylbenzene	142
Toluene	28
Xylene	440
Arsenic	50
Chromium	50
Copper	28
Lead	50
Zinc	100

The ROD stipulated that “ground water collection will continue until constituents have been recovered to the maximum extent possible,” as “determined during the Remedial Action, based upon experience in operating the ground water collection and treatment system, and [that] it must be as close to drinking water standards and no detectable carcinogenic PAHs to the maximum extent possible.”

The ROD specified that recovered groundwater would be treated on the Site by physical/chemical separation followed by filtration and activated carbon adsorption. A portion of the treated groundwater would be re-injected into the aquifer along with surfactants to help recover the contaminants. Excess treated groundwater would be discharged to the drainage ditch leading into

Hunting Bayou in accordance with a NPDES permit.

The ROD specified that once EPA had determined that groundwater constituents have been recovered to the maximum extent possible, groundwater collection would cease and any remaining constituents would be allowed to naturally attenuate to background levels. The ROD also indicated that the groundwater could be remediated via in-situ biological treatment, if equal performance was demonstrated.

The ROD specified a groundwater monitoring program that will continue for at least 30 years unless it could be shown during the Remedial Design that some shorter length of time is appropriate. Site operation and maintenance are to include installing a well screened in the 500 foot sand, monitoring groundwater wells and monitoring ambient air during remediation. This sampling program will monitor the effectiveness of the selected remedy and provide the data necessary to trigger corrective action, if necessary. If the monitoring shows leaching from soils now under existing structures, then the Site will need to be revisited to determine if further remediation is necessary. The monitoring data will be evaluated during EPA's five-year review to determine if any corrective action is necessary.

5 Remedy Implementation

5.1 Soil Remedy

Delineation of impacted soils at the Site was performed during the 1995 construction activities in accordance with the Confirmation Sampling Plan. The remedial design for the Site soil remedy was initiated by Dames & Moore in 1998 and completed in November of 1999. EPA approval of the concrete cap design was obtained on November 11, 1999.

Beazer contracted with Bay Ltd. to construct the soil remedy. Construction activities on the concrete cap began on November 17, 1999 and in accordance with the design parameters, the concrete cap was constructed to withstand truck traffic.

The soil remedial action concrete cap system was to cover impacted as well as non-impacted areas in the Southeast and the Southwest areas, therein providing usable parking and driveway systems for the current property owners. The extent of the concrete cap is shown in Figure 3. The concrete cap is eight inches thick in the Southwest area and 10 inches thick in the Southeast area. Soils in the Northeast area were not capped in place, but were excavated and used, along with existing on-site stockpiled materials, as fill under the concrete cap structures in the Southeast and Southwest areas. The Northeast area was then backfilled with clean imported fill from an off-site source.

Cap construction also provides a positive drainage system to eliminate standing rainwater and provides a cover for all presently known impacted soil surfaces. Provisions for storm water drainage and collection were provided in the design, and included the construction of a below-grade detention basin to comply with the City of Houston's permitting requirements. Cap construction work was completed in July 2000.

5.2 Groundwater Remedy

In March 1991, Beazer entered into a Consent Decree with EPA for implementation of the remedial design and remedial action for the Site. The proposed plan for completion of the remedial design process, including pre-design and pilot studies, was presented in the Remedial Design Work Plan (RDWP) which was submitted to EPA in March 1992. Pilot study tasks conducted to support the groundwater remedial design included a groundwater collection well pilot study, groundwater recovery trench pilot study and groundwater treatment system pilot study. Pilot study tasks were completed in October 1993. The final (100%) groundwater remedial design for the Site was approved by EPA in January 1995. Following approval of the remedial designs, Beazer prepared the *Remedial Action Work Plan* (RAWP) (Dames and Moore, 1995) which presented the procedures and requirements for construction of the remedial alternatives. The RAWP was approved by EPA in May 1995. Remedial construction was initiated in June 1995.

5.2.1 Groundwater Collection and DNAPL Recovery System

Construction for the groundwater collection and DNAPL recovery system was initiated in June 1995. Construction included the installation of 11 recovery wells.

One DNAPL recovery well (RWN-4) and four groundwater collection wells (RWN-1, RWN-2, RWN-3 and RWN-5) were installed within Groundwater Remedial Action Area (GRAA) 1 located in the northern section of the Site. One DNAPL recovery well (RWS-5) and three groundwater collection wells (RWS-3, RWS-4, and RWS-6) were installed within GRAA 2, which includes the area formerly occupied by the coal tar distillation plant. Two combined groundwater collection/DNAPL recovery wells (RWS-1 and RWS-2) were installed within GRAA 3, which includes the area formerly occupied by the wood treating process area. The DNAPL recovery wells were placed in the areas with potentially recoverable DNAPL (i.e. former process areas, areas where measurable thicknesses of DNAPL had been identified) and at locations corresponding to topographically low points in the upper surface of the basal confining unit. Thus, the DNAPL recovery wells were installed at optimal locations to remove any readily recoverable DNAPL. The DNAPL recovery was enhanced by a relatively low pumping rate of 1.9 gpm distributed across the four widely-spaced DNAPL recovery areas at the Site. The total pumping rate was relatively small and was applied over a large area. This resulted in limited mobilization of DNAPL to the recovery wells. Increasing the pumping rate would not have had an appreciable effect on DNAPL recovery given the relative immobility of coal-tar based DNAPL. Moreover, the low yield of the geologic formation would have limited any increase in the groundwater pumping rate (Key, 2011).

A total of 22 piezometers were installed as part of the groundwater remedial action (Figure 4). Startup of the groundwater collection and DNAPL recovery components of the groundwater remedy was conducted in September 1995, following completion of the groundwater treatment plant modifications.

In an EPA letter dated October 6, 1995 (EPA, 1995a), EPA indicated that “there is some question as to whether EPA will continue to apply the current remedial action goal to ground water cleanup.” The remedial goals specified in the ROD issued in 1988 specifies groundwater cleanup

to drinking water standards and no detectable carcinogenic PAHs. This direction was taken in response to a July 31, 1995 EPA memorandum (EPA, 1995b) directing a policy favoring ARAR waivers at sites where it is technically impracticable to remediate groundwater to Federal or State standards.

As provided by the October 6, 1995 EPA letter and, in accordance with an agreement between EPA and Beazer based on the EPA Memorandum “Superfund Groundwater RODs: Implementing Change This Fiscal Year” (EPA, 1995b) dated July 31, 1995, groundwater extraction to minimize off-site migration, and monitoring, were delayed pending determination of the potential inapplicability of the groundwater remedial goals specified in the 1988 ROD. Subsequent groundwater pumping and DNAPL recovery operations demonstrated the impracticability of the attainment of the 1988 ROD remedial goals. In a Memorandum “Clarification of OSWER’s 1995 Technical Impracticability Waiver Policy” dated September 19, 2011 (EPA, 2011) indicated that even when ARARs are waived at a Superfund site due to TI, pursuant to CERCLA Section 121(d)(4), the remedy must still be protective of human health and the environment. Hence the July 31, 1995 memorandum should no longer be considered when making current site decisions.

Since the 1995 EPA decision to re-evaluate the groundwater remedial goals, Beazer has done additional work (Ground Water Fate and Transport Evaluation Report – August 1997; Verification of Ground Water Fate and Transport Evaluation Report - July 2000; and, FFS – April 2011) to assess whether natural processes (e.g., adsorption, dispersion, and biodegradation) are effective in reducing concentrations of dissolved phase constituents to health-protective levels before groundwater migrates to locations where exposure to groundwater could reasonably occur, and to verify that natural attenuation is occurring. This re-evaluation is in keeping with the 1988 ROD language which allows for in-situ biological treatment of soil or groundwater if equal or better performance can be demonstrated. The ROD further allows for the determination of “maximum extent possible” remediation goals during the RA phase. The FFS Study Report dated April 2011 is further being evaluated by Beazer, EPA, and TCEQ.

Operation of the DNAPL recovery component of the groundwater remedy, including active groundwater pumping for gradient enhancement, continued for slightly over ten years from January 1996 through April 2006. Groundwater extraction was conducted in all three areas for gradient enhancement to optimize DNAPL recovery. Groundwater pumping was discontinued after a lightning related power surge occurred that damaged the system controller in April 2006. DNAPL recovery since that time has been completed in a passive mode (i.e., without groundwater pumping) via manual pumping of DNAPL from the collection wells. The plans for the system will be determined once the remedial alternative is selected as part of the FFS which is underway.

As of the First Five-Year Report dated September 25, 2002, approximately 2,800 gallons of DNAPL had been recovered from shallow water bearing zone DNAPL recovery wells RWS-1, RWS-2, RWS-5, and RWN-4. As of the Second Five-Year Report dated September 24, 2007, a total of approximately 4,013 gallons of DNAPL have been recovered via a combination of gradient enhanced pumping and passive recovery. As of December 2011 a total of 4,021 gallons of DNAPL have been recovered.

The FFS presented an estimate of the volume of DNAPL remaining at the Site. This estimate was

based on sampling of the DNAPL source zones, from which estimates of the volume of the source zones and an average concentration of the DNAPL were developed. The volume of soil in the source zone was estimated by integration of the areas of DNAPL source zones, and is as follows:

- Shallow source zone soil volume = $189,611 \text{ yd}^3 = 142,757 \text{ m}^3$;
- Intermediate source zone soil volume = $59,718 \text{ yd}^3 = 45,684 \text{ m}^3$;
- Intermediate aquitard source zone soil volume = $427,797 \text{ yd}^3 = 327,265 \text{ m}^3$; and,
- Total source zone soil volume = $677,126 \text{ yd}^3 = 515,706 \text{ m}^3$.

The average concentration of DNAPL within this source zone soil volume was conservatively assumed (i.e., likely an underestimate) to be 1000 mg/kg (~1 mL creosote per 1 kg of soil). The dry bulk density of the soil was assumed to be $1,780 \text{ kg/m}^3$. Consequently, the concentration of DNAPL is estimated at 1.78 kg/m^3 of source soil (~1.78 L and ~0.47 gal), and the total volume of DNAPL in the source is estimated at approximately 240,000 gallons (Key, 2011).

Only 20 gallons of DNAPL have been recovered since the cessation of gradient-enhancement pumping in April 2006. This is considered indicative of the immobile nature of the residual DNAPL at the Site. Analysis of the DNAPL recovery rate shows a noticeably decrease in the rate over the duration of the program. The maximum recovery rate (approximately 1.92 gpd) occurred in 1998 and 1999. The rate subsequently decreased to approximately 1.05 gpd, and was approximately 0.84 gpd during the last few years of the operation of the enhanced DNAPL recovery system. This trend indicates a diminishing return, in terms of the effort per unit volume of DNAPL recovered. Table 7 presents maximum, minimum and most recent DNAPL thickness measurements at wells and piezometers. The table demonstrates that DNAPL thickness has decreased significantly, but that there are some areas with potentially recoverable DNAPL. Although a large mass of DNAPL remains, the FFS notes that a significant portion of the DNAPL is unrecoverable by gravity drainage and will be retained in the formation by capillary tension (Key, 2011). Consequently, it is apparent that DNAPL recovery operations have been relatively ineffective given that less than 2% of the total DNAPL has been recovered over approximately 16 years of recovery operations, and the system as designed and operated would not be expected to be any more effective in the future should it be restarted.

In addition to the ongoing DNAPL recovery, Beazer has conducted annual groundwater monitoring of deeper groundwater. Sampling and analysis of well LCW-01, screened at a depth of 530 feet was conducted through 1996 and showed no Site-related impacts. The well is obstructed and has not been sampled since 1996. A shallower deep well (DW-02), screened at a depth of 220 feet has been sampled annually since 1993 and has never shown any Site-related impact. These wells are located just to the southwest of the South Cavalcade Street Site on American Warehouse property.

5.2.2 Groundwater Treatment Plant Construction

In 1993 the Groundwater Pilot Collection Trench (GPCT) and the Groundwater Pilot Treatment Plant (GWPTP) were completed. The construction of the GWPTP was completed by Peters Construction Company. Work included excavation and backfill, treatment plant piping, concrete structures, superstructures, mechanical, electrical and instrumentation equipment, and structural steel.

The GPCT was excavated using a biopolymer slurry. It was backfilled with select fill and on-site material. Collection pipes and sumps were installed to facilitate groundwater collection. Water collected from the GPCT was treated by the GWPTP.

The GWPTP was equipped to process water from the groundwater pumps. The processes included clarification, pH adjustment utilizing caustic and sulfuric acid additions, anionic polymer addition, and flocculation. The process also included air floatation, carbon adsorption, and air scouring. The GWPTP processed groundwater collected from the groundwater collection system.

In 1995 upgrades to the GWPTP were performed. Major upgrades included: installation, replacement and modification of pumps and required foundations; replacement of PVC piping with steel; installation of a new plant air compressor; installation of a new blower skid package; and installation of two heatless air dryers. Additional work included painting, tank modifications, piping modifications and other miscellaneous items. The upgrades were constructed by JWP Gowan, Inc. Additional services were supplied by Eagle Construction & Environmental Services, Inc.

The previously described GWPTP upgrades allowed for additional processes to be incorporated into the overall treatment process. Process additions include: metals pretreatment; sludge handling; material reuse, recycling, or disposal; carbon adsorption; effluent dissolved oxygen; flow control and storm water runoff. These process additions modified the GWPTP into a full-scale Ground Water Treatment Plant (GWTP).

In 2001, an additional filtering component was added to the GWTP to address a one-time exceedance of ammonia in the treatment effluent, thought to be related to cleaning of the plant tanks. However, Beazer up-graded the treatment plant to include additional filtration to remove any ammonia in the treated water as a precautionary measure.

The groundwater system was used to effectively treat groundwater prior to discharge as surface water to a proximate ditch. The groundwater and DNAPL were recovered and managed as separate liquids to reduce the constituent loading in the influent to the GWTP. The groundwater pumps in the collection wells were set several feet above the bottom of the well such that only groundwater was extracted through the wells and directed to the treatment plant. As such, the influent to the treatment system did not contain any non-aqueous phase liquid. The system operator removes DNAPL from the wells on an "as needed" basis using a portable pumping assembly. The recovered DNAPL is stored in a dedicated tank within the treatment plant area. Through April 2006, any water that separated from the DNAPL in the storage tank was decanted and directed through the treatment plant. Since the treatment plant became inoperative, limited DNAPL has been recovered and is stored on-site in a tank pending off-site disposal of both the DNAPL and separated water (if any).

5.3 Preliminary Close Out for Soils and Groundwater

A final Site inspection was conducted with EPA and TCEQ (then Texas Natural Resource Conservation Commission (TNRCC)) at the conclusion of the modified soil Remedial Action

(RA) construction activities on July 12, 2000. The Preliminary Close Out Report (PCOR), signed September 15, 2000, documented that Beazer had completed construction of all remedial designs in accordance with the 1988 ROD and 1997 ROD Amendment, and that institutional controls were in place. Based on additional information collected and provided by Beazer since the previous five-year review report, EPA and TCEQ are re-evaluating remedial goals set forth in the 1988 ROD and are considering options which may significantly change the groundwater collection, treatment, and monitoring requirements for the Site, as well as the cleanup goals. If remedial goals are changed to better address conditions of the Site, those changes will be made available for public comment and will be summarized in a ROD Amendment or Explanation of Significant Difference (ESD), as appropriate. After the final groundwater cleanup goals are met for the Site, EPA will issue a Final Close Out Report.

5.4 Implementation of Institutional Controls and Other Measures

The use of the Site is restricted to non-residential use by virtue of the respective Administrative Order on Consent (AOC) between the property owners and the EPA. Non-residential use is consistent with the exposure assumptions used to develop the remedial goals for soil. Site access is restricted to authorized personnel via fencing, locked access gates and on-site security personnel. The AOC also prohibits the installation of on-site water wells (except for the purpose of groundwater monitoring). Section 3.2 provides a more detailed description of the AOC. The soil cap maintenance requirements and on-site groundwater use restriction are part of the consent order between EPA and the property owners, but were not required to be written into the deed notice that was filed in the county land records. ICs should be developed such that when the property changes ownership, the new property owners are aware of the ICs and implement them.

The AOC provides an institutional control to eliminate the potential exposure pathway of exposure to on-site groundwater. For both on-site and off-site areas adjacent to the Site, the HGSD has notification and permitting requirements in place to further reduce groundwater use and to discourage the use of private wells where a public water supply is readily available. The purpose of the HGSD notification and permitting requirements is to reduce groundwater use and ground subsidence in Harris and Galveston Counties, but is not intended to prevent exposure to contaminated groundwater at the Site. Although the HGSD rules deny new well permits for most properties with an available alternative water supply, wells with a casing of less than five inches that serve only a single-family dwelling are excluded from the permit requirements. Evaluation of groundwater use in the vicinity of the Site from the well information provided by the HGSD, which was presented in the April 2011 FFSA, and the information from Texas Water Well data was conducted. The evaluations confirmed that there is no use of the shallow groundwater within a one-mile radius of the Site. There are a couple of intermediate zone wells that are domestic wells $\frac{3}{4}$ mile upgradient of the "Site". There are currently no institutional controls off-site in the plume area prevent the installation of a water well.

6 System Operations

6.1 Soil

The long-term operation and maintenance (O&M) of the soil remedy began after the construction of the concrete cap was completed in July 2000. However, the design of the concrete cap limits

the long-term maintenance required. The design spacing of the expansion joints has controlled concrete cracking to the joint locations. Long-term system operations of the concrete cap at the South Cavalcade Site consist of the following:

- Property owners inspect and repair cracks and joint systems as necessary;
- Beazer performs an annual inspection to ensure that the Long-Term Operation & Maintenance activities are carried out; and,
- Beazer submits a soil remedy Long-Term Operation and Maintenance Annual Report to the EPA.

The Long-Term Operation and Maintenance Annual Reports describe the condition of the Site, summarize O&M activities completed during the year, outline proposed activities for the coming year, and provide a certification that the remedy continues to provide the protection specified by the ROD. For the period covered by this review, annual inspections were completed, and annual reports were submitted, on the following dates:

- 2007: Annual Inspection – January 3, 2008; Annual Report – July 29, 2008
- 2008: Annual Inspection – February 26, 2009; Annual Report – April 30, 2009
- 2009: Annual Inspection – January 15, 2010; Annual Report – March 2, 2010
- 2010: Annual Inspection – December 30, 2010; Annual Report – February 24, 2011
- 2011: Annual Inspection – February 23, 2012; Annual Report – April 27, 2012

The annual inspections found that the concrete cap shows limited wear typical of curing, that joint systems are intact and functioning as designed, and that storm water flow is unobstructed and is occurring as intended. Minor issues identified during these inspections included a slightly displaced bollard, a few instances of joints and locations of removed sign posts needing re-caulking, weeds growing in joints, water ponding along the eastern edge of the Southeast Area, and two locations where a crack was forming. Therefore, the cap continues to provide protection of human health and the environment by eliminating a surface exposure pathway and preventing impact to groundwater by providing a barrier to surface infiltration. Continuing operation and maintenance activities are recommended in the annual reports. These routine maintenance activities are to be completed by the property owners and include the following:

- Inspect and repair joints as necessary;
- Remove weeds, and repair as necessary;
- Inspect and repair bollards and removed sign post area as necessary;
- Inspect and repair large cracks in the Southeast Area.

Representatives from EPA, TCEQ, U.S. Army Corps of Engineers (USACE), Beazer, and Key Environmental conducted an inspection of the cap on May 16, 2012 for this Third Five-Year Review. The caps in both the southeast and southwest areas were in good condition (Attachment 4). An offset in the pavement just to the east of the eastern edge of the southwest cap (Attachment 4) may have been the result of a washout created when the water supply line broke in the 2000-2001 timeframe. Although the offset does not appear to have impacted the integrity of the cap or the protectiveness of the remedy, EPA recommends that the cap be reevaluated annually to ensure that settling or cracking of the adjacent cap does not occur with time.

6.2 Groundwater

DNAPL recovery operations were initiated in conjunction with groundwater pumping during the November and December 1995 start-up/shakedown of the groundwater treatment system. In January 1996, operation of the DNAPL recovery system in the passive mode of operation (i.e. collection of DNAPL without groundwater pumping to increase hydraulic gradients) was initiated in accordance with the EPA-approved 100% Remedial Design.

In June 1996, groundwater extraction to enhance hydraulic gradients was initiated in one GRAA (GRAA 3) to evaluate the effectiveness and practicability of the enhancement prior to its use in the other GRAAs. Evaluation of the DNAPL recovery data collected from GRAA 3 from July through September 1996 indicated that groundwater extraction (at a pumping rate of 0.3 gallons per minute from individual recovery wells) appeared to enhance DNAPL recovery in wells RWS-1 and RWS-2. Based on this observation, DNAPL recovery with groundwater extraction to enhance hydraulic gradients was initiated in GRAAs 1 and 2 in October 1996. Groundwater extracted from the DNAPL recovery wells was directed to an on-site treatment system for treatment prior to discharge.

Enhanced DNAPL recovery was conducted in this manner from October 1996 through April 2006 when the enhanced groundwater recovery system became inoperative as a result of the lightning related power surge that damaged the system controllers. DNAPL recovery has been conducted in a passive mode since then. The system operator checks the DNAPL level once a month. The DNAPL accumulated in the recovery wells is removed by the system operator when the DNAPL thickness in the wells is approximately six inches. DNAPL collection is accomplished by pumping the DNAPL from the well into 55-gallon drums mounted on a portable trailer system. The operator then transfers the DNAPL from the drums into a 6,500-gallon steel tank located at the treatment system. Once sufficient DNAPL has been collected, Beazer has the recovered DNAPL shipped off-site for recycling or disposal. Any water that separates out from the DNAPL in the storage tank will be sent off-site for disposal.

Typical operations prior to April 2006 consisted of weekly measurements of DNAPL thickness in the recovery wells and removal of DNAPL that has accumulated to a thickness of more than one foot. No major operational problems exist with the DNAPL recovery system. The groundwater pumping and treatment system operated as intended until the lightning related power surge that damaged the controllers in April 2006. The system includes several pumps, flow meters and other equipment that require frequent routine maintenance and periodic replacement. DNAPL recovery data and system operations information are summarized in the quarterly progress reports prepared by Beazer for submission to EPA. The plans for the system will be determined once the remedial alternative is selected as part of the FFS.

As previously indicated, approximately 2,800 gallons of DNAPL had been recovered as of the First Five-Year Review. Approximately 1,213 gallons of additional DNAPL were recovered between the First and Second Five-Year Reviews and this corresponds to 60% reduction in the DNAPL recovery rate observed during the first five year period. Approximately 8 gallons of DNAPL have been recovered since the completion of the Second Five-Year Review in September 2007, to December 2011.

In addition to the ongoing DNAPL recovery operation, Beazer has conducted annual groundwater monitoring since March 1993 in deeper monitoring wells located in the vicinity of the Site, as stipulated in the ROD. This activity is independent of the natural attenuation assessment for shallow groundwater and is subject only to the applicable provisions of the ROD and EPA-approved Remedial Design Work Plan. The results of this activity have confirmed that the deeper groundwater-bearing units beneath the Site are not impacted. In addition, groundwater monitoring of the shallow zone and intermediate zone wells conducted during March 2011 show that natural attenuation is occurring and the plumes are stable or are decreasing.

6.3 Operation and Maintenance (O&M)

Beazer initially contracted Roy F. Weston, Inc. to operate and maintain the DNAPL recovery and groundwater treatment system. In 1997, Beazer contracted Remediation Technologies, Inc. (RETEC) to provide operation and maintenance services. Field & Technical Services, LLC (FTS) was contracted to provide the operation and maintenance services in January 2006. Long-term monitoring and maintenance activities for the cap are completed in accordance with the O&M plan incorporated into the Remedial Action Work Plan (RAWP), as modified in November 1999 and approved by EPA. The Groundwater Extraction System Performance Monitoring Plan (GESMPM), included as Appendix A.2 of the RAWP, describes performance monitoring and data evaluation for the groundwater collection and DNAPL recovery systems. As previously indicated, groundwater collection and treatment were conducted through April 2006 to enhance DNAPL recovery. Ongoing O&M activities include cap maintenance (conducted by the property owners) and operation and maintenance of the DNAPL recovery system (conducted by FTS on behalf of Beazer).

Quarterly progress reports are submitted to EPA to document ongoing O&M activities at the Site, to report DNAPL volumes recovered, and, through April 2006, to document the volume of groundwater treated and discharged. Fifty-three (53) Quarterly Progress Reports have been submitted as of February 2012, in accordance with Section XI of the March 1991 Consent Decree for Remedial Design/Remedial Action. Monthly effluent reports for the treatment plant were submitted to TCEQ and EPA in accordance with the requirements of expired Texas Permit No. WQ0003388-000. Because treatment and discharge of groundwater ceased with the shutdown of the groundwater extraction and treatment system in April 2006 and there are no longer effluent discharges from the Site, Beazer has been submitting the Monthly Effluent Report along with the Quarterly Progress Reports, instead of submitting them monthly since June 2007. This change in report submittals has been approved by the EPA and TCEQ.

O&M costs have included those associated with O&M of the groundwater and DNAPL collection and management/treatment systems; effluent monitoring, groundwater quality monitoring (deep aquifer), cap inspections, and reporting. The O&M costs over the period covered by this review were not provided to the review team and were not evaluated in this review.

7 Progress since the Last Five-Year Review

Activities conducted since the last five-year review process consisted of multiple remediation, investigative, and reporting tasks as follows:

- Operation of the DNAPL recovery system;

- Completion of routine cap maintenance activities;
- Completion of deep wells annual groundwater monitoring;
- Completion of one round of shallow wells groundwater monitoring
- Completion of annual cap inspections;
- Completion of a FFS;
- Preparation of quarterly progress reports;
- Preparation of annual cap inspection reports; and,
- Completion of the Third Five-Year Review Site Inspection.

In addition to completing the scheduled O&M and reporting, Table 2 provided at the end of the report describes the progress made in addressing the issues identified in the last five-year review.

8 Five-Year Review Process

8.1 Administrative Components

The South Cavalcade Site Third Five-Year Review was conducted in accordance with the EPA's Comprehensive Five-Year Review Guidance (EPA, 2001). The five-year review for this Site was initiated by the EPA which tasked the USACE to perform the technical components of the multidisciplinary review. This review was conducted by environmental engineer John Hickman and geologist John Lambert. The following team members provided information and assisted in the review:

- Raji Josiam, EPA Remedial Project Manager for the South Cavalcade Site
- Ms. Fay Duke, Project Manager, TCEQ Remediation Division
- Michael Bollinger, P.E. - Environmental Manager, Beazer East, Inc.
- James Zubrow, P.G. - Principal Hydrogeologist, Key Environmental, Inc.

The Third Five-Year Review consisted of document reviews (Attachment 1), interviews (Attachment 2), and Site inspection findings (Attachments 3 and 4) conducted on May 16, 2012.

8.2 Community Involvement

A public notice announcing initiation of the five-year review was published in the Houston Chronicle newspaper on April 29, 2012. The notice invited recipients to provide questions to Raji Josiam, EPA Remedial Project Manager, by phone or e-mail. Upon signature, the Five-Year Review report will be placed in the information repositories for the Site, including the Houston Central Library, the Site repository, the TCEQ office in Austin, Texas, and the EPA Region 6 office in Dallas, Texas. A notice will be published in the Houston Chronicle to summarize the findings of the review and announce the availability of the report at the information repositories. A copy of the initial public notice is provided as Attachment 5 to this report.

8.3 Document Review

This Third Five-Year Review included the review of relevant Site documents, including the ROD and ROD Amendment, O&M records, annual Site inspection reports, Site investigation reports, and the FFS. Documents reviewed are listed in Attachment 1.

8.4 Data Review

DNAPL recovery data are summarized by Beazer and are included in the quarterly progress reports submitted to EPA. The enhanced recovery of DNAPL ceased in April 2006 when the programmable logic controller for the DNAPL recovery well groundwater treatment system was damaged by a lightning strike. Since April 2006 DNAPL recovery has been conducted by passive operation of the DNAPL recovery system (collection of DNAPL without groundwater pumping to increase hydraulic gradients). The most recent quarterly progress report for the “Site” shows that from the completion of the last five-year review in September 2007 to December 2012, eight gallons of DNAPL were recovered (Beazer, 2012).

Review of annual deep groundwater monitoring data indicates that deep groundwater has not been affected by the Site. There have been no detections of any of the PAHs being analyzed in sampling from the deep monitoring wells. Table 3 from the Report of Findings - 2011 Deep Monitoring Well Sampling and Analysis (FTS, 2011) presents the deep groundwater sampling data. In Table 3, the numerical values associated with non-detects should be clarified in a footnote. Future reports of the groundwater sampling results should include this information. Sampling of the Shallow and Intermediate Zones was conducted in March 2011.. Groundwater monitoring of the shallow zone and intermediate zone wells conducted during March 2011 show that natural attenuation is occurring and the plumes are stable or are decreasing. Review of data summarized in the 2011 FFS indicates that the extent of DNAPL and dissolved phase constituents do not appear to be increasing in size.. Tables 4, 5 and 6 present the historical Shallow and Intermediate Zone sampling data. In Tables 4, 5 and 6 the definition and determination procedures for the “reporting limits” associated with non-detects should be clarified in a footnote. This information is important for assessing data quality and usability and should be included in future reports of groundwater sampling results.

The ROD identified groundwater remedial goals for carcinogenic PAHs, benzene, ethylbenzene, toluene, xylene, arsenic, chromium, copper, lead and zinc. The groundwater monitoring described in the GESMP requires analyzing for parameters for which there are remedial goals specified in the ROD. The FFS (Key, 2011) and the *Supplemental Groundwater Investigation Report* (Key, 2006) present groundwater sampling analytical results for benzene and naphthalene, but do not present analytical results for the other constituents with remedial goals. Groundwater samples should be analyzed for all the groundwater constituents in which the ROD specified remedial goals, and the results should be included in groundwater monitoring reports.

8.5 Site Inspection

Representatives of EPA, TCEQ, USACE, Beazer, and Key Environmental took part in a Site inspection on May 16, 2012 for the Five-Year review. Attachment 3 is the Site inspection checklist, and Attachment 4 is the Site inspection photographs. The following personnel were present during the Site inspection.

- Michael Bollinger, Beazer
- Terry Andrews, TCEQ
- Sherell Heidt, TCEQ

- John Hickman, USACE
- Raji Josiam, EPA
- Jim Zubrow, Key Environmental

Site inspection tasks included a visual inspection of Site features including the concrete cap, monitoring wells, and fences and gates. The groundwater pumping and treatment system has been shut down since April 2006 due to the lightning related power surge that damaged the controllers. The system was operated as intended until then. The groundwater treatment plant has not been in operation since 2006 and was not inspected. The plans for the system will be determined once the remedial alternative is selected as part of the FFS.

Most of the Site is fenced in, with only the southwest area, the parking lot for the office of a trucking company, being unfenced, which includes the southwest concrete cap. Both the southwest and southeast areas of the Site are occupied by trucking firms, with the areas used for truck parking and maintenance, and warehouses. The northern portion of the Site was formerly a trucking terminal, but is now unoccupied. Most of the southern and northern areas are paved, with the central portion of the Site being an empty field covered with native vegetation.

The wells in the southern portion of the Site are all flush mount or contained in vaults. The well and the vault covers were found to be in good condition, except that some of the wells were unlabeled or the labels were unreadable. Monitoring wells in northern area have well pads and above ground well casings and protective casings. Wells in the northern area were observed with missing or unreadable labels, missing caps, and damaged well pads. An unlabeled well was found outside of the fenced and secure Site boundaries west of the northern area. The well, which appears to be MW-25, was found to have no locking cover to prevent access to the well cap. The 2006 Supplemental Groundwater Investigation (Key, 2006) attempted to sample 21 existing monitoring wells and piezometers at the Site. Five wells could not be sampled because four wells could not be located, and one well was damaged. Additionally, deep well LCW-01 has not been sampled since 1996 due to an obstruction in the well. A complete inspection of all the wells at the Site should be conducted to identify problems with the wells. Wells should be labeled, with caps on the well casing and locking covers on the protective casing. Damaged well pads should be replaced. Damaged and un-restorable wells should be evaluated for usefulness, and either plugged and abandoned or replaced.

The concrete caps in both the southeast and southwest were in good condition (see photographs Attachment 4). Minor surface cracks were observed which are believed to be associated with the curing of the concrete. These cracks should be monitored for any significant changes over time. Minor weed growth was observed in some of the joints in the southeast cap, which should be removed. A 1/4 to 1/2 inch crack at the eastern portion of the southeast cap was observed that had been identified in previous Site inspections. This crack should be sealed with caulk. One joint near the eastern edge of the southeast cap has a noticeable gap, and should be re-caulked. The caulking at the base of one bollard at the southwest cap has a noticeable gap, and should be re-caulked.

An offset in the pavement was observed just to the east of the eastern edge of the southwest cap and may have been the result of a washout created when the water supply line broke during

2000-2001 timeframe. The offset appears to be the same as observed in the 2002 and 2007 Five-Year Reviews. This offset in the concrete is not on the cap and does not appear to have impacted the integrity of the cap or the protectiveness of the remedy. The eastern edge of the southwest cap should continue to be monitored for impacts from a historical water line break.

Action items from this inspection are:

- Monitor the eastern edge of the southwest cap for impacts from a historical water line break.
- Monitor the surficial cracks (from curing) in the caps for any significant changes over time.
- Seal the observed crack in the southeast cap.
- Re-caulk the gaps at the base of the bollard in the southwest cap, and the joint in the southeast cap.
- Inspect all wells and perform maintenance and repairs as necessary.

These action items do not indicate any problems which would impact the remedy protectiveness for human health and environment. Rather, these are monitoring actions to detect changing conditions with the cap, and actions to maintain the groundwater well system needed to provide the required groundwater monitoring at the Site.

8.6 Interviews

As part of the five-year review, interview forms were provided to the following people and organizations;

Raji Josiam, Remedial Project Manager, EPA

Fay Duke, Project Manager, TCEQ

Terry Andrews, Geologist, TCEQ

Michael Bollinger, Remediation Manager, Beazer

Jim Zubrow, Project Manager and Principle Hydrogeologist, Key Environmental

Ceil Price, Senior Assistant City Attorney, City of Houston

Mike Perez, Project Manager, Harris County Toll Road Authority

Mike King, Owner of Palletized Trucking

Jevic Transportation, Inc.

American Warehouses, Ltd.

In addition to the interviews, the published public notice announcing the beginning of the review invited input from the public. The interview forms that were returned can be found in Attachment 2. Below is a summary of the interview forms that were returned to the review team.

Ms. Raji Josiam is the Remedial Project Manager for the Site. Ms. Josiam discussed the contacts EPA has had with the City of Houston and HCTRA regarding the toll road expansion. EPA and the TCEQ have reviewed initial plans for the expansion in the vicinity of the Site and are currently waiting to review their updated schedule and design plans for the expansion. Discussions have taken place with Beazer, Key Environmental, the TCEQ, the EPA HQ, and the EPA Region 6 personnel regarding the remedial action alternatives for the northern portion and for the southern portion of the Site. These alternatives are currently being evaluated given the Site specific operations and conditions. Different questions have been raised during the discussions and in

order to address these Beazer has been gathering information and has been evaluating remedial alternatives. This has been an involved process and in order to sufficiently address the questions raised, the ROD Amendment timeline has been moved from 2012 to 2013.

Ms. Josiam stated that currently there are no active remedial operations at the Site. The one community concern is the offsite plume in the southern portion of the Site. A TI Waiver zone along with institutional controls need to be established for the on-site and off-site plumes. No specific community concerns have been brought to her attention regarding the operation and maintenance at this time. Recently there have been a few inquiries concerning the northern portion of the Site where different trucking companies are interested in buying the property. These interested parties have all been provided with the EPA guidance and policy documents regarding “due diligence” requirements related to Superfund Sites. Ms. Josiam is not aware of any problems associated with the Site, and stated that the ROD Amendment scheduled to be issued in 2013 will address the remedial actions for the Site.

Ms. Fay Duke is the TCEQ Project Manager for the Site. Ms. Duke states the caps appear well maintained and functioning as intended, and that EPA, TCEQ and the performing party are working on amending the groundwater remedy. Ms. Duke states that additional groundwater monitoring and evaluation need to be conducted as part of the amended remedy analysis, and that institutional controls should be implemented to restrict off-site groundwater use.

Mr. Jim Zubrow is a principal hydrogeologist and project manager for Beazer’s technical consultant (Key Environmental, Inc.). Mr. Zubrow is also a partner in Field & Technical Services (FTS) who performs the operation, maintenance and monitoring of the DNAPL recovery system at the Site. Mr. Zubrow has been involved in work at the Site since the Remedial Design phase (circa 1993). Mr. Zubrow listed the studies that had been completed in the progress towards amending the ROD for the groundwater remedy. Mr. Zubrow is completing studies in progress towards amending the ROD for the groundwater remedy and conducting the Site O&M and submitting the documentation associated with this work. No major issues have been identified in the work he oversees. Mr. Zubrow believes that the O&M at the “Site” could be optimized by reducing the frequency of the O&M visits without any adverse consequences.

Mr. Mike Perez is the Project Manager for HCTRA. He indicated that there is ongoing communication between EPA and HCTRA regarding the Toll Road Construction project and feels that EPA has kept HCTRA informed regarding “Site” activities. No issues were identified.

Mr. Mike King owns Palletized Trucking. The trucking company occupies the southeast portion of the Southern Area, which includes the southeast cap. Palletized Trucking performs the O&M on the Southeast Cap. Mr. King has a good impression of the work at the Site and the only problem he identified is a manhole cover that had not been repaired, however, no problems with manhole covers were observed during the Site inspection.

8.7 Exposure Pathways

A review of land use at the Site and in the Site vicinity indicates no substantial changes. The on-site buildings are still present and a secure (locked) fence still surrounds most of the Site. No residences have been constructed closer to the Site than were present when the 1988 risk

assessment was completed. Potential on-site soil exposure has actually been reduced because the areas with elevated PAH concentrations have been capped, thereby eliminating the exposure pathways discussed in the 1988 ROD.

In support of the potential monitored natural remedy being proposed for the Site, a Technical Memorandum presenting the results of the updated Human Health Risk Assessment (HHRA) for the South Cavalcade Street Superfund Site has been prepared (ARCADIS, 2011). The EPA and TCEQ comments on this HHRA is currently being reviewed by Beazer. The updated HHRA will assess potential current and future health risks associated with concentrations of constituents in groundwater to which people who work and live on and near the Site may potentially be exposed. This risk assessment will evaluate potential exposure pathways for the current and future conditions at the “Site” and will include potential inhalation of indoor air for the current and future on-Site worker, potential direct contact with groundwater (both dermal and ingestion exposure routes) as well as inhalation of trench air for the future utility worker and excavation air for the future construction worker at on-Site source entry points, and potential direct contact (dermal and ingestion) as well as inhalation of shower air for a hypothetical future off-Site resident.

Groundwater at the Site is currently not used on or off-site and future on-site use is precluded through the application of the restrictions in the AOC. The dissolved phase plume at the Site does not appear to be increasing in size based on available data. At this point in time, a complete exposure pathway is not identified as drinking water is provided by the City and there are no known private wells down-gradient of the plume. The revised risk assessment being conducted by ARCADIS includes exposure to groundwater by on-site utility and construction workers, and by off-site highway construction workers and residents.

As previously indicated, the HCTRA and City of Houston have proposed an extension to the Hardy Toll Road and expansion of Collingsworth Street. The Toll Road extension is proposed to be built along the rail right-of-way adjacent to the western boundaries of the South and North Cavalcade Street Superfund Sites. The Toll Road, if constructed as planned, will further separate these industrial properties from the neighborhood to the west. The ARCADIS risk assessment includes highway construction workers as potential receptors.

9 Technical Assessment

The following conclusions support the determination that the soil and groundwater remedial actions at the South Cavalcade Site are expected to be protective of human health as indicated below, and identify uncertainties which need to be addressed to ensure future protectiveness of the remedies.

The soil remedial actions implemented at the Site are protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. The concrete cap ensures current and future protection of human health and the environment.

The groundwater remedy is protective in the short term but future protectiveness depends on the demonstration that the DNAPL and plume are not migrating vertically and horizontally, and the

implementation of institutional controls to prohibit use of off-site contaminated groundwater. The FFS evaluated the migration potential DNAPL and concluded that since the releases occurred prior to 1962, that the DNAPL distribution is likely to be stable at the Site. Also, no DNAPL movement has been observed either directly (via the accumulation of DNAPL in down-gradient wells), or indirectly (as evidenced by an increase in the contaminant plume size) (Key, 2011). Figure 11 shows the inferred extent of DNAPL in the Shallow and Intermediate Zones.

Enhanced DNAPL recovery ceased in April 2006 and approximately 240,000 gallons of residual DNAPL still exist at the Site. This DNAPL will continue to serve as an on-going source of groundwater contamination into the foreseeable future. The FFS evaluated the distribution and potential migration of the dissolved phase constituents. The report presents multiple supporting arguments demonstrating that the plume is attenuating with increasing distance from the source. Tables 4, 5 and 6 present the groundwater sampling data collected in the Shallow and Intermediate Zones, and Figures 12, 13 and 14 show the locations of the sample locations and areas of impact. While the information presented supports the argument that attenuation of the plume is occurring, there is less information supporting the argument that the plume is stable or decreasing, partially due to the lack of sampling data collected near the leading edge of the plumes, and partially due to the lack of data collected at the same location over time. Also, the data in the FFS only presents the sampling analyses for benzene and naphthalene, so that the distribution and potential migration of the other groundwater constituents with remedial goals is not presented. Of the 42 groundwater sampling locations presented in Tables 4, 5 and 6, only nine locations had the four or more data points needed to perform a Mann-Kendall trend test. Of these nine locations, only two were downgradient relative to the source zones. Additional groundwater monitoring data should be conducted with the goals of establishing the current boundaries of the plume, and to continue to demonstrate that the plume in both the Shallow and Intermediate Zones is migrating or is stable or decreasing.

Review of the local hydrologic conditions was completed during the FFS to locate the nearest downgradient points where groundwater could potentially discharge to a surface water body. The nearest possible discharge points correspond to a stream named Little Whiteoak Bayou. In the Northern Area of the Site, the nearest downgradient discharge point is approximately 7,400 feet hydraulically downgradient from the western limit of the Potential DNAPL Source Area (PDSA), and in the Southern Area of the Site, the nearest downgradient discharge point is approximately 4,100 feet hydraulically downgradient from the PDSA. For both the Northern and Southern Areas, it can be concluded that the dissolved plumes have attenuated at least three-quarters of a mile upgradient of the nearest possible surface water discharge point (Key, 2011).

Available information shows that groundwater is not being used at the Site. As part of the Ground Water Fate and Transport Evaluation Report (GFTER) Verification, off-site groundwater usage in the vicinity of the Site was assessed via a well survey. The results of the survey showed that shallow groundwater is not used within a one mile radius of the Site. A more recent evaluation of groundwater use in the vicinity of the Site from the well information provided by HGSD was presented in the April 2011 FFS submitted by Beazer. The HGSD rules do not require permits for wells with a casing diameter of less than five inches that serve only a single-family dwelling. Hence as part of this Five Year Review, an evaluation to the Texas Water Well data was conducted. The evaluations confirmed that there is no use of the shallow groundwater within a

one-mile radius of the Site. There are a couple of intermediate zone wells domestic wells $\frac{3}{4}$ mile upgradient of the site.

Institutional controls such as the Administrative Order on Consent restrictions ensure that future use of the Site remains non-residential and prohibit on-site groundwater use. The HGSD regulates the installation of water wells and groundwater withdrawals in Harris and Galveston counties. HGSD rules require a permit before drilling a new well in most instances, However, ~~however~~, the HGSD rules do not require permits for wells with a casing diameter of less than five inches that serve only a single-family dwelling. Although the HGSD rules state that permits for new wells will be denied on a property that has an available alternative water supply, the permit can be approved if the HGSD determines through sufficient credible evidence that extraordinary circumstances require the property owner to drill a new well (HGSD, 2012). While the HGSD rules greatly reduce the possibility that a water well will be installed off-site in the in the area of the plume, the rules do not prohibit this from occurring. Institutional controls should be implemented to prohibit access to groundwater by off-site properties in the area of the contaminant plume.

The ROD specified a groundwater monitoring program that will continue for at least 30 years unless it can be shown during the Remedial Design that some shorter length of time is appropriate. This was to include installing a well screened in the 500 foot sand and monitoring groundwater wells during remediation. The Groundwater Extraction System Performance Monitoring Plan (GESMP) was developed in 1995 and is presented in Appendix A.2 of the RAWP. The GESMP describes the groundwater monitoring plan for the Site. The purpose of the groundwater monitoring was to monitor the performance and effectiveness of the groundwater collection system and DNAPL recovery system at the Site. Included in this plan is a requirement to monitor the shallow aquifer on an annual basis to delineate the areas of the groundwater exceeding the remedial goals. Any proposed modifications to the GESMP are to be submitted to EPA for approval prior to implementation.

As indicated earlier in this five-year review report, based on the EPA Memorandum “Superfund Groundwater RODs: Implementing Change This Fiscal Year” (EPA-540-F-99-005 OSWER-9335.5-03P) dated July 31, 1995 the EPA and, Beazer agreed to reconsider groundwater remedial alternatives outlined in the ROD, including options such as natural attenuation, or a Technical Impracticability (TI) waiver. In accordance with this agreement between EPA and Beazer, groundwater collection and treatment were delayed pending determination by EPA whether the groundwater remedial goals specified in the ROD are potentially inapplicable and a TI waiver appropriate. In a Memorandum “Clarification of OSWER’s 1995 Technical Impracticability Waiver Policy” (OSWER Directive #9355.5-32) dated September 19, 2011 indicated that even when Applicable or Relevant and Appropriate Requirements (ARARs) are waived at a Superfund site due to TI, pursuant to CERCLA Section 121(d)(4), the remedy must still be protective of human health and the environment. Hence the July 31, 1995 memorandum should no longer be considered when making current site decisions. Although annual monitoring of the deep aquifer has been occurring since 1993, only five sampling events of the shallow and intermediate aquifers have occurred in the 19 years since 1993, and the most recent sampling was conducted in March 2011. The groundwater monitoring has not been including all the groundwater constituents with remedial goals specified in the ROD. The GESMP called for analyzing for these constituents in groundwater monitoring at the Site.

Groundwater samples should be analyzed for all the groundwater constituents in which the ROD specified remedial goals, and the results should be included in groundwater monitoring reports.

EPA has since provided guidance to reinstate groundwater monitoring. Both the first and second five-year reviews state that the groundwater monitoring should be reinstated. Because there has been a long delay in developing the revised groundwater remedy and there is uncertainty as to when this will be accomplished, a groundwater monitoring plan should be developed and monitoring reinstated without waiting for the development and implementation of the revised remedy. Annual monitoring should be conducted as specified in the GESPMP until a new monitoring system is identified and a new monitoring frequency is established as part of the ROD Amendment. The groundwater monitoring will be used to verify the effectiveness of the current implemented remedy and to provide sufficient information to develop and support the revised groundwater remedy.

Evaluation of the Proposed Alternative Remedy

Beazer has been evaluating an alternative remedy for the Site in cooperation with EPA and TCEQ, and has presented an analysis and description of a proposed alternative remedy in the FFS (Key, 2011). EPA is evaluating the proposed alternative remedy and has requested additional information from Beazer. The FFS evaluated four potential remedial alternatives identified and selected through a series of recent discussions between Beazer, EPA, and TCEQ. The four alternatives are as follows:

- No Further Action;
- Monitored Natural Attenuation with No Further Action for Source Zone;
- Monitored Natural Attenuation with Continued Source Removal; and,
- In-Situ Solidification/Stabilization (S/S) of Accessible Source Materials.

The FFS selected remedy is monitored natural attenuation with no further action for source zone. This remedy would consist of the development and implementation of a MNA program. The primary objectives of the MNA program would be to provide ongoing confirmation that natural attenuation is effective in controlling migration of Site constituents and also to provide for the early detection of any upward trends indicative of potential constituents of interest migration. The major components of this remedy would be:

- Discontinue the operation of the existing groundwater pumping/DNAPL recovery system;
- Establish the necessary groundwater monitoring system to allow for the collection of additional groundwater data to better detect any future changes in Site groundwater conditions;
- Establish TI Zones consisting of the delineated source areas and the downgradient areas where dissolved constituent concentrations exceed groundwater remedial goals and ARARs;
- Obtain a TI Waiver of the groundwater remedial goals within the TI Zone; and
- Establish institutional controls to prohibit groundwater use within the TI Zone in perpetuity.

Groundwater treatment and solidification/stabilization (S/S) or other alternative methods would be employed as contingencies under this alternative in the event that monitoring data indicate that natural attenuation is not capable of achieving Site remedial objectives.

The proposed remedy includes both the northern and southern DNAPL/plume areas, and would leave the DNAPL source areas in place with no additional removal. The FFS estimated the total time for naphthalene to attain standards via natural attenuation to be 173 years or more. Although no estimate was provided in the FFS, the larger, more recalcitrant and more toxic PAHs could be expected to persist longer. Leaving the DNAPL in place with no additional removal increases the risk of future downward migration through the clay unit beneath the Intermediate Zone, and potential contamination of the deeper water bearing zone. Leaving the DNAPL in place also increases the time to achieve the groundwater remedial goals, increasing the time of potential exposure. Because leaving the DNAPL in place with no additional removal increases the potential risk of future migration of and exposure to the contaminants, additional consideration should be given to alternative methods of removing, degrading, destroying or immobilizing the DNAPL. Alternative methodologies that could be considered include dual phase extraction, in-situ biological treatment with surfactant flushing, and in-situ thermal treatment. As part of the remedy evaluation, a pilot study should be performed to evaluate potential technology viability and effectiveness for the site conditions prior to remedy implementation. The FFS should include information indicating that alternative remedies such as these have been considered, and their potential feasibility in comparison to the four alternatives that were presented.

The remedy proposes the establishment of TI Zones consisting of the delineated source areas and the downgradient areas where dissolved constituent concentrations exceed groundwater remedial goals and ARARs, however, the proposed remedial goals are not specified. The ROD specified remedial goals for cPAHs, BTEX and metals, listed in Section 4.3, and the GESPMP called for analyzing these constituents in groundwater monitoring at the Site. Of the constituents with remedial goals established in the ROD, only BTEX and naphthalene are included in the list of water quality parameters to be analyzed in the Long Term Monitoring Plan proposed in the FFS. If this proposed alternative is adopted, the initial list of analytes should include all constituents identified in the HHRA as existing at levels presenting an unacceptable risk or hazard. Only after sufficient groundwater data has been collected to determine the boundaries of the areas where dissolved constituent concentrations exceed groundwater remedial goals and ARARs, and it has been established that the plume is not migrating for these constituents, should the list of analytes be reduced.

9.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is not functioning completely as intended by the decision documents, however, an alternative remedy is being evaluated. The components of the remedy designed to ensure the short term protectiveness and most of the components designed to ensure long term protectiveness have been implemented and are effective. The remedy specified in the ROD included a groundwater extraction and treatment system that was to be continued until groundwater contaminants have been recovered to the maximum extent possible. The groundwater extraction and treatment system was to include the collection of non-aqueous phase liquids (NAPLs). While an enhanced DNAPL collection system was operated from 1996 to 2006, and the system has been operated in passive mode since 2006, the groundwater extraction and treatment system was not placed into operation although some groundwater extraction and treatment occurred as part of the enhanced DNAPL recovery. This was due to EPA concluding that there was a possibility

groundwater remedial goals specified in the ROD would need to be revised based on a change in policy at EPA. Since 1995, a complete implementation of the remedy specified in the ROD has been delayed while an alternative groundwater remedy has been under evaluation.

Components of the remedy that have been implemented include the following.

- *Health and Safety Plan (HASP)/Contingency Plan:* The HASP is in place. This plan was revised in October 2011 and is sufficient to control risks on-site, and is properly implemented.
- *Implementation of Institutional Controls and Other Measures:* The use of the Site is restricted to non-residential use by virtue of the respective Administrative Order on Consent (AOC) between the property owners and the EPA. Non-residential use is consistent with the exposure assumptions used to develop the remedial goals for soil. Site access is restricted to authorized personnel via fencing, locked access gates and on-site security personnel. The AOC also prohibits the installation of on-site water wells (except for the purpose of groundwater monitoring). Thus, this institutional control eliminates one of the potential groundwater exposure pathways identified in the ROD and ensures that the selected groundwater remedy remains protective. For those areas adjacent to the Site, the HGSD has notification and permitting requirements in place to further reduce groundwater use and to discourage the use of private wells where a public water supply is readily available. Although HGSD rules greatly reduce the possibility of off-site use contaminated groundwater, they do not completely prohibit it. Institutional controls should be implemented to prohibit access to groundwater by off-site properties in the area of the contaminant plume.
- *Remedial Action Performance:* Installed portions of the soil remedy are operating as anticipated. The concrete cap is effective in protecting human health and environment by eliminating direct contact with surface soils by on-site occupants. The cap has also provided positive drainage preventing standing surface water. The DNAPL recovery and groundwater treatment systems functioned as designed until April 2006 when a lightning related power surge affected the controllers. DNAPL is being removed via use of the four recovery wells which continue to operate in a passive mode. The DNAPL and dissolved phase constituent plume do not appear to be increasing in size based on available data. Monitoring data indicate that the treatment system was effective in reducing constituent concentrations to levels less than the discharge standards while the system was in operation.
- *System Operations/O&M:* The long-term operation and maintenance (O&M) of the soil remedy was initiated after the construction of the concrete cap was completed in August 2000. The O&M procedures, including annual inspections, should maintain the effectiveness of the remedial actions. The DNAPL recovery system continues to operate in a passive mode. The enhanced gradient groundwater pumping was conducted through April 2006 but is currently inoperative. Groundwater pumping and treatment have been discontinued pending evaluation of the focused feasibility study for Site groundwater.
- *Groundwater Monitoring:* The ROD stated groundwater monitoring will continue at least 30 years of at the Site unless it was demonstrated during the remedial design that some shorter length of time was appropriate. The groundwater monitoring plan presented in the GESMP was developed in 1995 as part of the RAWP to support the groundwater extraction and treatment system, but it appears that the groundwater monitoring plan was

never implemented due to the agreement between EPA and Beazer to delay the implementation of this component of the remedy. The deep aquifer has been monitored annually since 1993, and there has been occasional monitoring of the Shallow and Intermediate Zones, however, this monitoring has not been consistent with the GESMP. Because there has been a long delay in developing the revised groundwater remedy and there is uncertainty as to when this will be accomplished, a groundwater monitoring plan should be developed and monitoring reinstated without waiting for the development and implementation of the revised remedy. Annual monitoring should be conducted as specified in the GESMP until a new monitoring system is identified and a new monitoring frequency is established as part of the ROD Amendment. The groundwater monitoring will be used to verify the effectiveness of the current implemented remedy and to provide sufficient information to develop and support the revised groundwater remedy. The groundwater monitoring has not been including all the groundwater constituents with remedial goals specified in the ROD. The GESMP called for analyzing these constituents in groundwater monitoring at the Site. Groundwater samples should be analyzed for all the groundwater constituents in which the ROD specified remedial goals, and the results should be included in groundwater monitoring reports.

- *Costs of System Operations/O&M:* O&M costs for both the soil remedy and for the operation and maintenance of the DNAPL recovery and groundwater treatment system have been within an acceptable range. Groundwater extraction and monitoring to minimize off-site migration have been suspended since 1995, and therefore are not reflected in the O&M costs provided in the past five-year reviews. The O&M costs over the period covered by this review were not provided to the review team and were not evaluated in this review.
- *Opportunities for Optimization:* Due to the current adequate performance of the concrete cap at the time of this Five-Year Review, a need for optimization for the soil has not been identified. Similarly, the DNAPL recovery system and groundwater treatment plant performed as expected through April 2006. Opportunities for optimization appear to exist with respect to the enhanced gradient pumping and groundwater treatment system. A FFS that addresses Monitored Natural Attenuation as an alternative remedy for the Site is currently being evaluated by Beazer, EPA, and TCEQ.
- *Early Indicators of Potential Remedy Failure:* No early indicators of potential failure of the soil and groundwater remedies were noted during the review. However, as discussed in this review, the groundwater component of the remedy has not been implemented as a reevaluation of the groundwater remedy is under review.

9.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

The purpose of this question is to evaluate the effects of any significant changes in standards or assumptions used at the time of remedy selection. Changes in promulgated standards or “to be considered” (TBC) and assumptions used in the original definition of the remedial action may indicate that an adjustment in the remedy is necessary to ensure the protectiveness of the remedy.

Changes in ARARs. Applicable or Relevant and Appropriate Requirements (ARARs) for this site were identified in the ROD dated September 1988 and the Amended ROD of May 1997. The

five-year review for this Site included identification of and evaluation of changes in the ROD-specified ARARs to determine whether such changes may affect the protectiveness of the selected remedy. A comprehensive list of ARARs identified in the 1988 and 1997 RODs is provided below.

The ARARs identified by the 1988 ROD were divided by Federal and State, and are separated into chemical-specific, action-specific, and location-specific categories. The selected remedy complied with those Federal and State requirements that were applicable or relevant and appropriate for the remedial actions.

Chemical-Specific ARARs:

Chemical specific ARARs are usually health or risk based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment.

- National Primary Drinking Water Standards established at 40 CFR 141 and expressed as maximum contaminant levels (MCLs), and the National Secondary Drinking Water Standards established at 40 CFR 143 and expressed as Secondary MCLs (SMCLs), promulgated under the Safe Drinking Water Act (SDWA).
- Ambient Water Quality Criteria established at 40 CFR 131, promulgated under the Clean Water Act (CWA).
- Best Available Technology (BAT) treatment standards for the Organic Chemical, Plastics, and Synthetic Fibers effluent guidelines (40 CFR 414), as regulated under the National Pollutant Discharge Elimination System (NPDES) at 40 CFR 122 and 125, and the National Pretreatment Standards for discharges to a Publicly Owned Treatment Works (POTW), as regulated at 40 CFR 403, established under the CWA.
- Texas Allowable Limits of Metals in Drinking Water regulations at 30 TAC 290.
- Texas Surface Water Quality Standards (TSWQSs) at 30 TAC 307 establishes limits for constituents for the protection of surface water quality in Texas.
- Texas Control of Air Pollution From Visible Emissions and Particulate Matter at 30 TAC 111 prohibits air contaminants which adversely affect human health.

Action-Specific ARARs:

Action-specific ARARs are typically technology or activity-based requirements applicable to actions involving special categories of wastes. Action-specific requirements are usually triggered by certain remedial activities that may be a component of the overall cleanup alternative. The following action-specific requirements were identified in the ROD as applicable during remedial actions:

- Occupational Safety and Health Act (OSHA) regulations pertaining to worker protection and safety, as regulated at 29 CFR 1910.
- Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities – 40 CFR 264 Subpart F (Release from Solid Waste Management Units), Subpart G (Closure and Post Closure), Subpart J (Tanks), and Subpart N (Landfills)
- Resource Conservation and Recovery Act (RCRA) requirements for the transportation of hazardous materials, as regulated at 49 CFR 170-179 and 40 CFR 263.
- Standards for Generators of Hazardous Wastes at 40 CFR 262.

- Criteria for Classification of Solid Waste Disposal Facilities and Practices at 40 CFR 257.
- Land Disposal Restrictions (LDRs), as regulated at 40 CFR 268.
- Texas Prohibition of Air Contaminants which Adversely Affect Human Health at 30 TAC 113.
- Texas Storage of Volatile Organic Compounds regulations at 30 TAC 115.
- Texas Oil/Water Separator regulations at 30 TAC 113.530.

Location-Specific Requirements

Location-specific ARARs are restrictions placed on remedial activities solely on the basis of the location of the remedial activity. Some examples of locations that might prompt a location-specific ARAR include wetlands, sensitive ecosystems or habitats, floodplains, areas of historical significance. The following location-specific ARARs are applicable:

- Texas Location of Wells Used for Drinking Water Supplies at 30 TAC 290.

The 1988 ROD specified the Maximum Contaminant Level Goals (MCLGs), established at 40 CFR 141, as “to be considered” (TBC) for the selected remedy. Some of these MCLGs now have established MCLs (see below). The Amended ROD only identified 40 CFR 264 Subpart G (Closure and Post Closure) and Subpart N (Landfills) as additional ARARs for the selected remedy.

The ROD stipulated as ARARs the Ambient Water Quality Criteria at 40 CFR 131 and the TSWQS. The Ambient Water Quality Criteria would apply to compounds which the State does not regulate. The TSWQS are updated regularly, with the most recent update being in 2010. Portions of the 2010 standards are under review by the EPA. As such, the most recent standards should be used to evaluate the effectiveness of the remedy. Once EPA has approved the proposed changes to the TSWQS, site remedial goals should be reevaluated to address the current applicable water quality rules.

There have been no other changes in these ARARs, standards, or TBCs that would affect the protectiveness of the remedy. EPA continues to evaluate the potential inapplicability of the groundwater remedial goals specified in the ROD in consideration of the policy enacted in 1995 that favors waivers of State and Federal standards at sites, such as the South Cavalcade Site, where it may be technically impracticable to remediate groundwater to these criteria. Any modifications, however, to remedial goals will have to also meet the protectiveness standard.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics.

No changes in exposure pathways have occurred that would adversely affect the short-term protectiveness of the remedies. No new contaminants, sources, or routes of exposure were identified as part of this Five-Year Review. Additionally, there are no current or planned changes in land use. The Site continues to be used for non-residential purposes and future use must remain non-residential in accordance with the restrictions established in the 1992 AOC entered into by the EPA and the property owners. Property owners have increased the amount of paved area at the Site, benefiting the overall serviceability of the cap system. The concrete cap is expected to perform consistently with the expectations of the Amended ROD and effectively eliminates this exposure pathway.

The ROD was prepared based on the assumption that future exposure to groundwater could occur if on-site groundwater wells were installed or if there was further off-site migration to a point of exposure. The 1992 AOC among the EPA and property owners prohibits the installation of on-site water wells (except for the purpose of groundwater monitoring). This institutional control eliminates one of the potential exposure pathways identified in the ROD and increases the protectiveness of the selected groundwater remedy. For those areas adjacent to the Site, the HGSD has notification and permitting requirements in place to further reduce groundwater use and to discourage the use of private wells where a public water supply is readily available. Although HGSD rules greatly reduce the possibility of off-site use of the contaminated groundwater, they do not completely prohibit it. Institutional controls should be implemented to prohibit access to groundwater by off-site properties in the area of the contaminant plume.

Available information shows that groundwater is not being used at the Site. As part of the GFTER Verification, off-site groundwater usage in the vicinity of the Site was assessed via a well survey. The results of the survey showed that shallow groundwater is not used within a one mile radius of the Site. A more recent evaluation of groundwater use in the vicinity of the Site from the well information provided by HGSD was presented in the April 2011 Final Focused Feasibility Study submitted by Beazer and the information from the Texas Water Well data was conducted. The evaluations confirmed that there is no use of the shallow groundwater within a one-mile radius of the Site. There are a couple of intermediate zone wells that are domestic wells $\frac{3}{4}$ mile upgradient of the site.

Since the ROD was approved and the completion of the this Five-Year Review, the toxicity value used by EPA for their Integrated Risk Information System has changed for at least three compounds:

- The Reference Dose (RfD) for oral exposure for benzene was newly added at 4×10^{-3} mg/kg-day in April 2003.
- The RfD for oral exposure for toluene was decreased from 0.2 mg/kg-day to 0.08 mg/kg-day in September 2005.
- The RfD for oral exposure for xylenes was decreased from 2.0 mg/kg-day to 0.2 mg/kg-day in February 2003.
- The RfD for oral exposure for zinc was increased from 0.21 mg/kg-day to 0.30 mg/kg-day in August 2005.

However, these changes would have only impacted conditions as they existed at the “Site” prior to remediation. Post-remediation “Site” conditions eliminated or reduced the exposure pathways, effectively negating the impact of the change in exposure assumptions.

The ROD also listed the primary drinking water standards promulgated under the Safe Drinking Water Act (SDWA), expressed as MCLs, as an ARAR for the site. Some MCLs have changed or been established for some additional contaminants and are as follows:

- Arsenic changed from 50 to 10 µg/L in 2002
- Chromium changed from 50 to 100 µg/L in 1991
- Lead changed from 50 to 15 µg/L (EPA Action Level) in 1991
- Copper was set at 1,300 µg/L (EPA Action Level) in 1991
- Ethylbenzene was set at 700 µg/L in 1992

- Toluene was set at 1,000 µg/L in 1992
- Xylene was set at 10,000 µg/L in 1992
- Benzo(a)pyrene was set at 0.2 µg/L in 1994

The groundwater remedial goals for arsenic and lead were based on MCLs of these constituents at the time of the ROD. Because the MCLs have decreased since then, consideration should be given to revising the remedial goals for arsenic and lead and institutional controls are to be implemented prohibiting groundwater use off-site in the plume area. However, because groundwater is not currently being used at the Site and in the vicinity downgradient of the “Site”, this change in the MCLs does not affect the current protectiveness of the remedy. The remedial goals for ethylbenzene and toluene were based on BAT monthly discharge limits at the time of the ROD because MCLs had not been established. Since then, MCLs have been established that are greater than the remedial goals established in the ROD. The remedial goal for xylenes appears to have been based on a proposed drinking water standard, however, the MCL that has since been established for xylene is greater than the remedial goal established in the ROD. The MCLs that have been established for ethylbenzene, toluene and xylene are greater than the remedial goals, which indicates the remedial goals are protective. A drinking water action level for copper of 1,300 µg/L was established in 1991, and is well above the remedial goal of 28 µg/L, which indicates the adopted remedial goal is protective of human health. The remedial goal for zinc is intended to prevent exposure to zinc above the reference dose. The reference dose for zinc has increased since the ROD was issued, therefore the remedial goal for zinc remains protective of human health. The remedial goal for cPAHs is “No Detection”, and this remedial goal remains protective of human health. However, any consideration of revising this remedial goal in the future should include a complete review of the current toxicity characteristics of PAHs at the Site as part of the risk assessment.

There have been no other significant changes in exposure pathways, toxicity characteristics, or other contaminant characteristics for the “Site”, therefore the protectiveness of the remedies still remain. Protectiveness will be re-evaluated in view of a potential monitored natural attenuation remedy.

There have also been no other changes to the standardized risk assessment methodology that would affect the protectiveness of the remedy. A new human health risk assessment is being prepared for the Site in view of a potential monitored natural attenuation remedy, but was not finalized or approved prior to the performance of this Five-Year Review.

9.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has been identified that would call into question the protectiveness of the soil and DNAPL remedies. The plume appears to be stable, and pumping of groundwater to enhance DNAPL recovery appears to provide no additional benefit. Beazer, EPA, and TCEQ are in the process of evaluating a Focused Feasibility Study regarding Monitored Natural Attenuation as the long-term remedy for Site DNAPL and groundwater. However, worker protection must be considered during construction of portions of the Hardy Toll Road and along Collingsworth as subsurface work will provide a short-term duration for exposure for contaminated groundwater.

Level C protective clothing is recommended. In addition, care must be taken during construction to avoid creating any conduits or pathways for migration of DNAPL to the deeper aquifers. These considerations will be discussed with both the HCTRA and City of Houston.

10 Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Shallow rooted vegetation observed in the expansion joints along the eastern edge in the Southeast area.	N	Y
2. The owner of the Northern Area is unknown and needs to be determined to ensure that the AOC is still effective for institutional controls.	N	Y
3. Ground water collection and DNAPL recovery system may no longer be the best remedial alternative.	N	Y
4. There is no groundwater monitoring plan being implemented and the groundwater monitoring is insufficient.	N	Y
5. The groundwater monitoring has not been including all the groundwater constituents with remedial goals specified in the ROD. The GESMP called for analyzing for these constituents in groundwater monitoring at the Site.	N	Y
6. There are insufficient institutional controls preventing use of the off-site contaminated groundwater.	N	Y
7. The Toll Road extension and Collingsworth Street expansion may impact the Site.	N	Y
8. The groundwater remedial goals for arsenic and lead were based on the MCLs of these constituents at the time of the ROD. The MCLs have decreased since the issuance of the ROD, and the remedial goals are now above the MCLs.	N	Y
9. Unable to locate in public records the plat and survey of impacted area and cap.	N	N
10. Monitoring wells are in need of repair.	N	N

11 Recommendations and Follow-up Actions

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Planned Completion Date
1. Shallow rooted vegetation	<ul style="list-style-type: none"> The property owners should inspect and maintain joint systems and repair cracks and 	Property Owners Beazer	EPA TCEQ	Ongoing

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Planned Completion Date
	joint systems as required. <ul style="list-style-type: none"> • Beazer is responsible for continuing annual cap inspections. 			
2. The owner of the Northern Area is unknown and the effectiveness of the AOC needs to be verified	<ul style="list-style-type: none"> • A Title Search is to be conducted to determine the current owners • Conduct a record search and discuss with current landowners the AOC and ensure the landowners are aware of the ICs and that the ICs are being implemented. 	EPA Landowner	EPA TCEQ	September 2013
3. Current groundwater remedy may not be the best Remedial Alternative	<ul style="list-style-type: none"> • Evaluation of the FFS supporting Monitored Natural Attenuation as an alternative remedial action for groundwater is to be continued. As part of this re-examination of remedial options and objectives, groundwater monitoring requirements and extraction to contain the dissolved plume should also be evaluated and reinstated as appropriate. It must be also continued to be demonstrated that the DNAPL and plume are not migrating vertically and horizontally. 	Beazer EPA TCEQ	EPA TCEQ	September 2013
4. Groundwater monitoring is insufficient and there is no groundwater monitoring plan being implemented	<ul style="list-style-type: none"> • A groundwater monitoring plan should be developed and monitoring reinstated without waiting for the development and implementation of the revised groundwater remedy. Annual monitoring should be conducted as specified in the GESPMP until a new monitoring system is identified and a new monitoring frequency is established as part of the ROD Amendment. 	Beazer EPA	EPA TCEQ	September 2013

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Planned Completion Date
5. The groundwater monitoring has not been including all the groundwater constituents with remedial goals specified in the ROD.	<ul style="list-style-type: none"> Groundwater samples should be analyzed for all the groundwater constituents in which the ROD specified remedial goals, and the results should be included in groundwater monitoring reports. 	Beazer EPA	EPA TCEQ	September 2013
6. ICs preventing off-site use of groundwater are insufficient	<ul style="list-style-type: none"> Institutional controls prohibiting off-site use of the groundwater in the area of the contaminant plume should be implemented. 	Beazer EPA	EPA TCEQ	December 2015
7. Toll Road Extension and Collingsworth Street Expansion may impact site	<ul style="list-style-type: none"> Continued discussions are to be held with the Harris County Toll Road Authority (HCTRA) and the City of Houston concerning potential Site impacts of the expansion to be considered. Worker health and safety should be considered for those areas where short-term contact with ground water contamination is anticipated. Precautions should also be taken during construction to prevent the creation of conduits and preferential pathways for migration of DNAPL to deeper aquifers. 	EPA HCTRA	EPA HCTRA City of Houston	Ongoing
8. The groundwater remedial goals for arsenic and lead are greater than the current MCLs	<ul style="list-style-type: none"> Consideration should be given to revising the groundwater remedial goals for arsenic and lead. Implementation of ICs to prevent groundwater use off-site in the plume area 	Beazer EPA	EPA TCEQ	<ul style="list-style-type: none"> September 2013 December 2015
9. Unavailability of plat and survey in public records	<ul style="list-style-type: none"> Ensure the plat and survey of the impacted area and cap are part of the Administrative Record and entered into county 	EPA	EPA TCEQ	September 2013

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Planned Completion Date
	land records.			
10. Monitoring wells are in need of repair	<ul style="list-style-type: none"> All wells should be inspected to evaluate their condition. The wells should have caps, locking protective casing lids, labels, and sound well pads. Lost wells should be located, and damaged and inoperable wells should be evaluated for usefulness and either be plugged and abandoned or replaced. 	Beazer EPA	EPA TCEQ	September 2013

12 Protectiveness Statement

The remedy for the overall South Cavalcade Superfund Site is protective of human health and the environment for the short term.

The soil remedial actions implemented at the Site are protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated.

The groundwater remedy is protective in the short term but future protectiveness depends on the implementation of institutional controls to prohibit use of off-site contaminated groundwater. Institutional controls such as the Administrative Order on Consent restrictions ensure that future use of the Site remains nonresidential and prohibit on-site groundwater use. Current information shows that shallow and intermediate groundwater are not currently being used downgradient in the vicinity of the Site and deeper groundwater has not been impacted by Site-related constituents.

13 Next Review

This is a statutory review that requires ongoing five-year reviews. The next review will be conducted within five years of the completion of this Five-Year Review report. The completion date is the date of the signature shown on the summary of findings page attached to the cover sheet.

14 References

- ARCADIS U.S., Inc., April 2011. *Technical Memorandum - South Cavalcade Superfund Site Human Health Risk Assessment*.
- ARCADIS U.S. Inc., April 2012. *Long-Term Operations and Maintenance Report (Soil Remedy), South Cavalcade Superfund Site – Concrete Cap*.
- Beazer East, Inc., February 2012. *South Cavalcade Superfund Site Quarterly Progress Report #53*.
- Dames & Moore, May 1995. Modifications incorporated November 1999. *Final Remedial Action Work Plan*.
- EPA, September 1988. *Record of Decision South Cavalcade Street Site, Houston, Texas*.
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- EPA, May 1997. *Amended Record of Decision No. 1 South Cavalcade Street Site, Houston, Texas*.
- EPA, June 2001. *Comprehensive Five-Year Review Guidance*. OSWER No. 9355.7-03B-P.
- EPA, September 2002. *Five-Year Review South Cavalcade Street Site, Houston, Harris County Texas*.
- EPA, September 2007. *Five-Year Review South Cavalcade Street Site, Houston, Harris County Texas*.
- Field & Technical Services (FTS), May 2011. *Report of Findings - 2011 Deep Monitoring Well Sampling and Analysis - South Cavalcade Superfund Site Houston, Texas*.
- Harris-Galveston Subsidence District (HGSD), February 2012. *Rules*.
- Key Environmental, Inc. August 1997. *Groundwater Fate and Transport Evaluation Report, South Cavalcade Superfund Site, Houston, Texas*.
- Key Environmental, Inc., July 2000. *Verification of Groundwater Fate and Transport Evaluation, South Cavalcade Superfund Site, Houston, Texas*.
- Key Environmental, Inc., March 2006. *Supplemental Groundwater Investigation Report, South Cavalcade Superfund Site, Houston, Texas*.

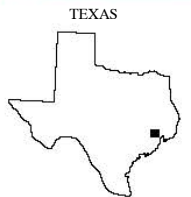
Key Environmental Inc., April 2011. *Final Focused Feasibility Study South Cavalcade Superfund Site*.

Keystone Environmental Resources, Inc. August 1988a. *Feasibility Study South Cavalcade*.

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EPA, September 19, 2011 *Clarification of OSWER's 1995 Technical Impracticability Waiver Policy* (OSWER Directive #9355.5-32)

Figures and Tables



REFERENCE:

ISSUE DATE:

KEY ENVIRONMENTAL, INC.
200 THIRD AVENUE
CARNEGIE, PA 15108

DRWN: WAA	DATE: 07/18/07
CHKD: GLC	DATE: 07/18/07
APPD: JSZ	DATE: 07/18/07
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SITE LOCATION MAP

PROJECT NO: 07-480

FIGURE 1



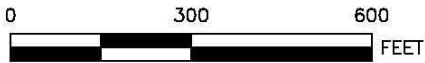
Figure 2. Aerial View of the South Cavalcade Street Superfund Site

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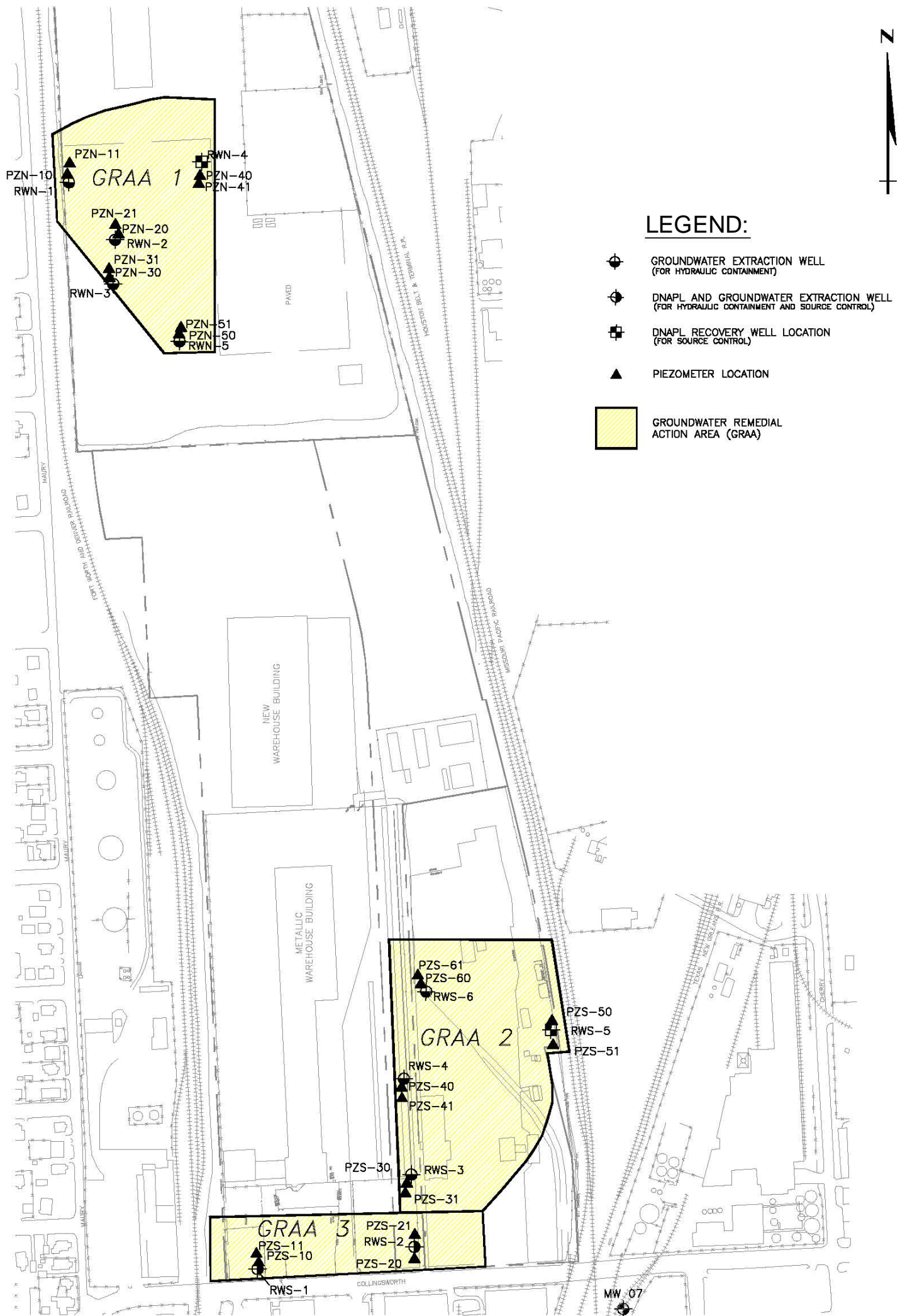
- SOUTH CALCADE SITE BOUNDARY
- PROPERTY BOUNDARIES
- AREAS COVERED WITH ASPHALT OR CONCRETE
- CONCRETE CAP CONSTRUCTED BY BEAZER



BEAZER EAST, INC. PITTSBURGH, PENNSYLVANIA		
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CHKD: RJH	DATE: 2/11/11	
APPD: JSZ	DATE: 2/11/11	
SCALE: AS SHOWN	KEY ENVIRONMENTAL INCORPORATED	
FOCUSED FEASIBILITY STUDY SOUTH CALCADE SUPERFUND SITE HOUSTON, TEXAS		
GENERAL SITE ARRANGEMENT		PROJECT NO: 11-233 FIGURE 3

REFERENCE:		ISSUE DATE:	
KEY ENVIRONMENTAL, INC.		200 THIRD AVENUE	
CARNEGIE, PA 15106			
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PITTSBURGH, PENNSYLVANIA

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DATE: 07/18/07



SECOND FIVE YEAR REVIEW REPORT
SOUTH CAVALCADE SUPERFUND SITE
BEAZER EAST, INC.
HOUSTON, TEXAS

GROUNDWATER AND DNAPL
RECOVERY SYSTEM

PROJECT NO: 07-480
FIGURE 4

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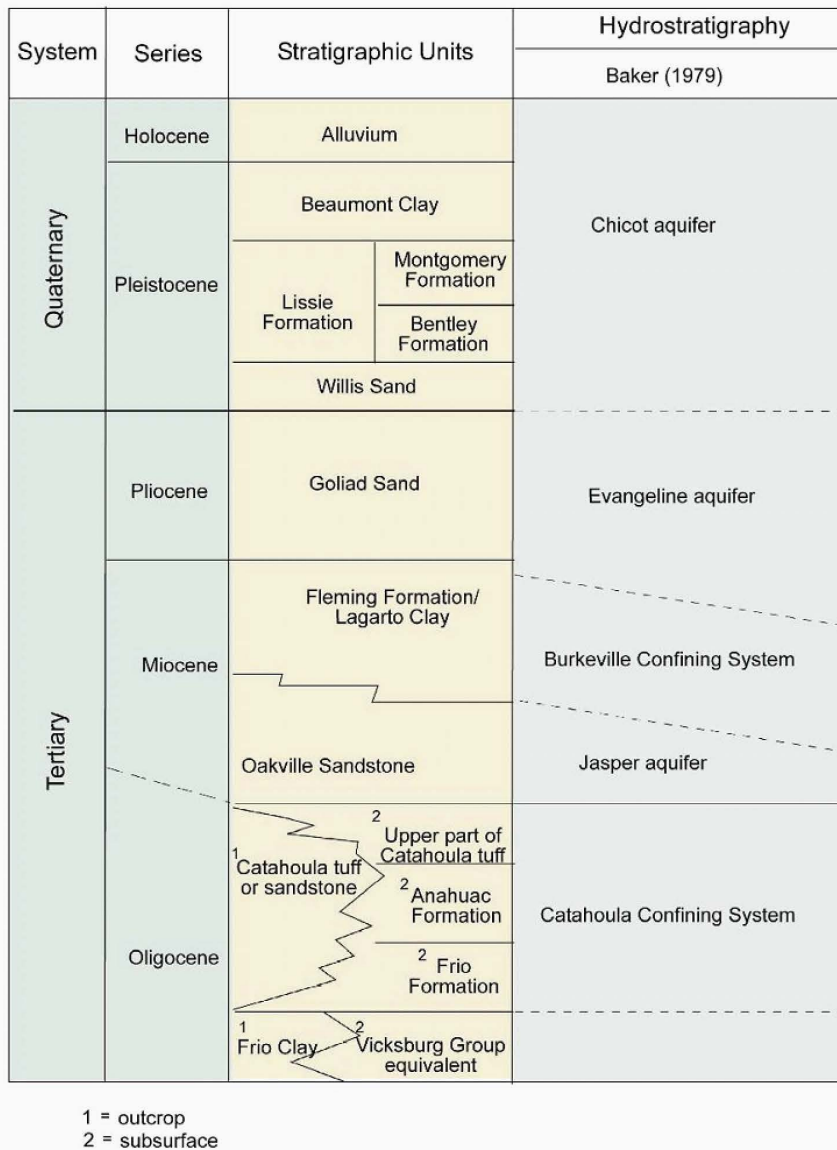


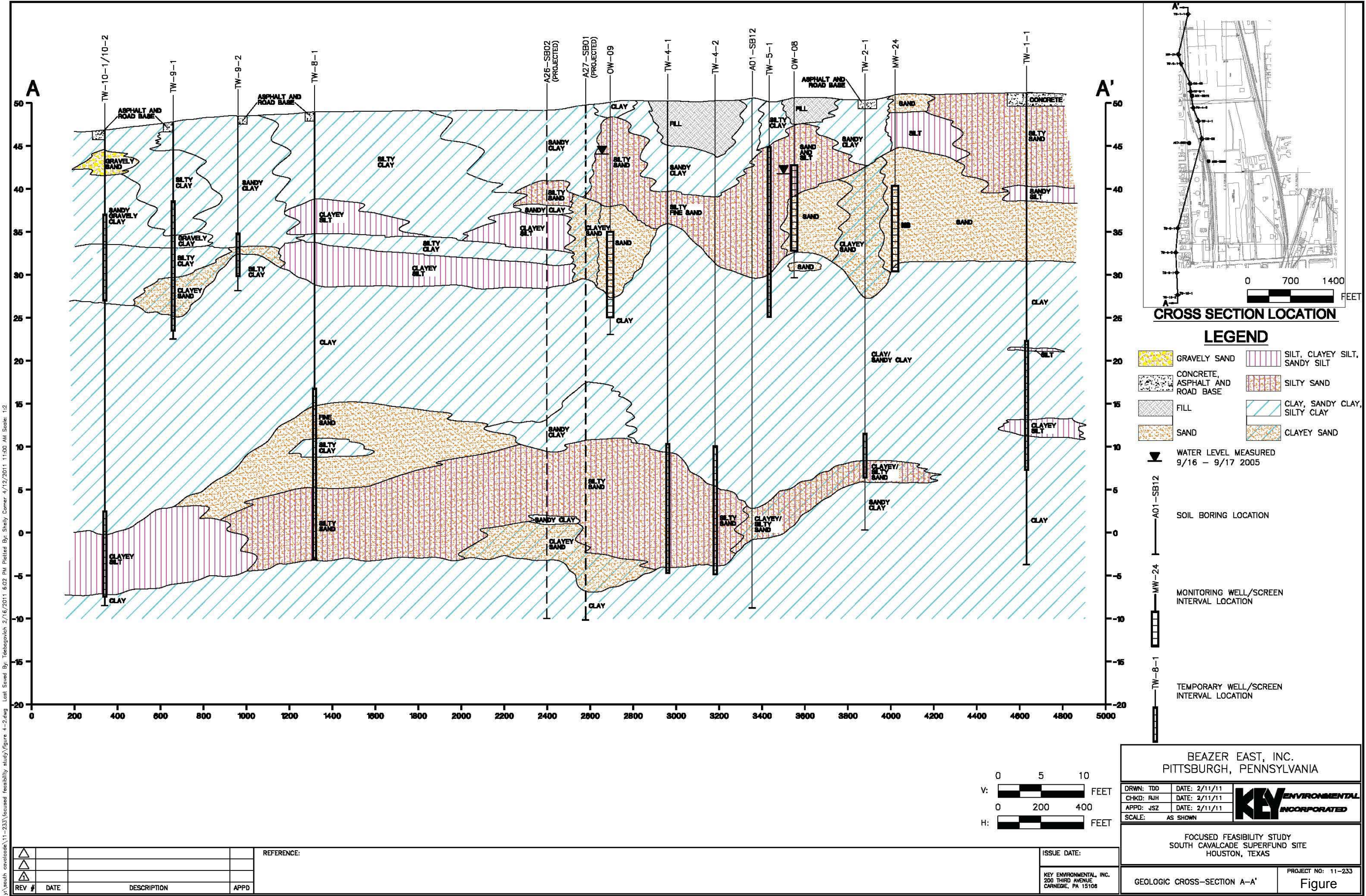
Figure 4-1. Stratigraphic column showing the correlation between stratigraphy and hydrostratigraphy in the Gulf Coast Aquifer (after Baker, E.T., 1979. Stratigraphic and hydrogeologic framework of part of the coastal plain of Texas; Texas Department of Water Resources Report 236).

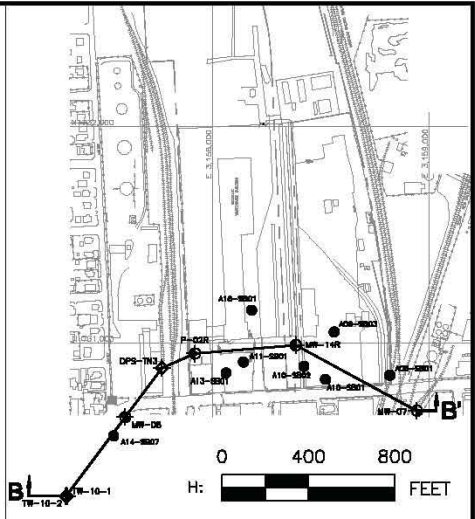
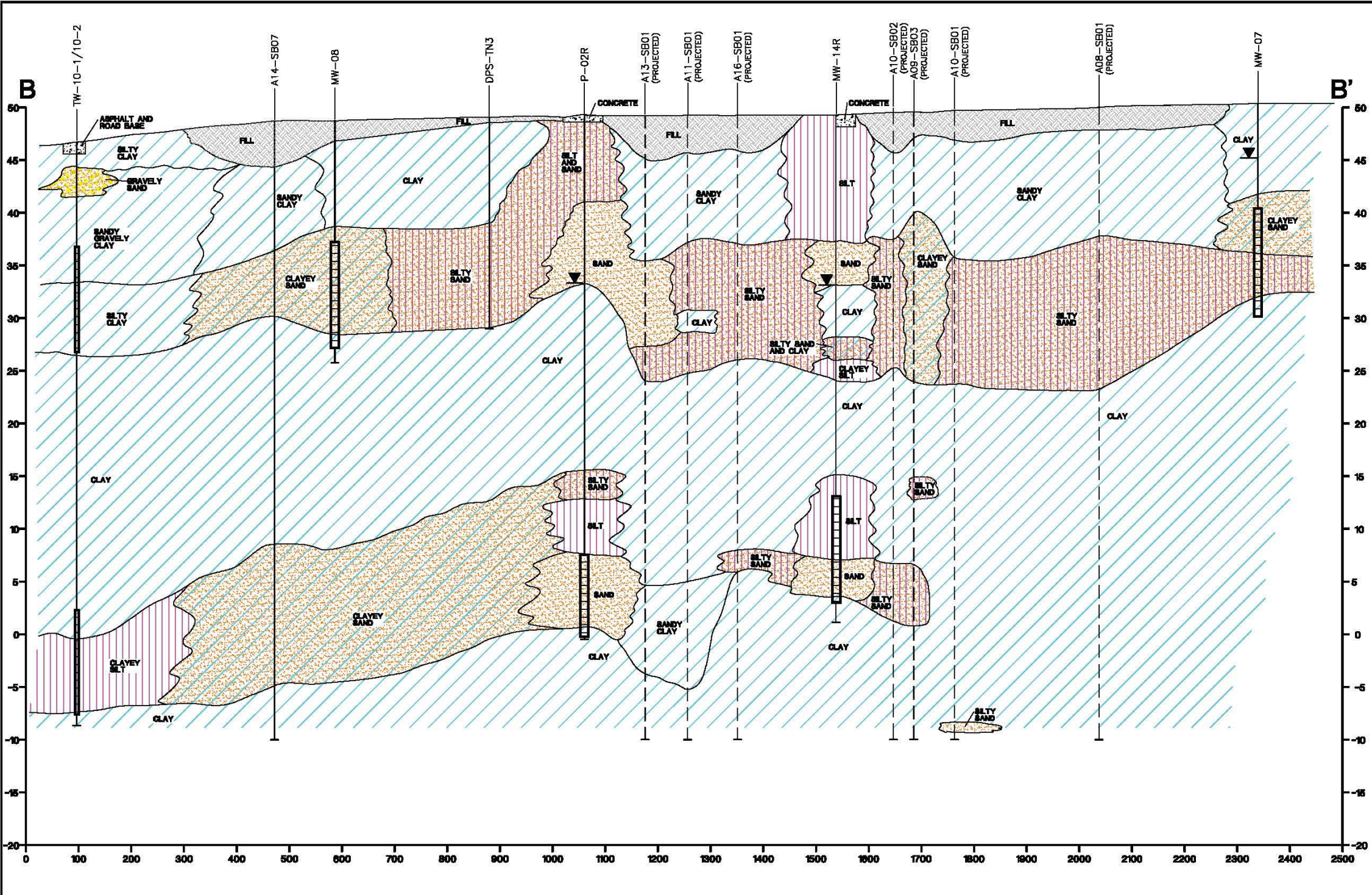
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FOCUSED FEASIBILITY STUDY SOUTH CAVALCADE SUPERFUND SITE HOUSTON, TEXAS			
STRATIGRAPHY AND HYDROSTRATIGRAPHY COLUMN IN THE GULF COAST AQUIFER		PROJECT NO: 11-233 Figure	

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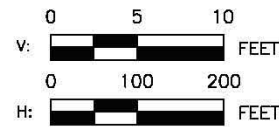
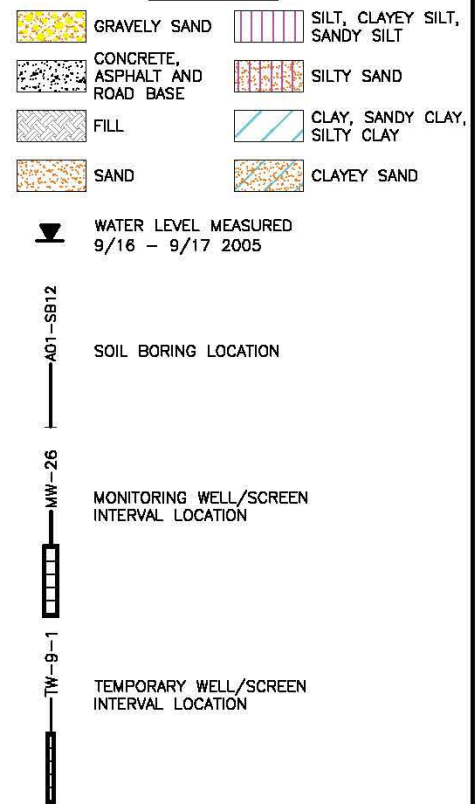
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CARNEGIE, PA 15106





CROSS SECTION LOCATION

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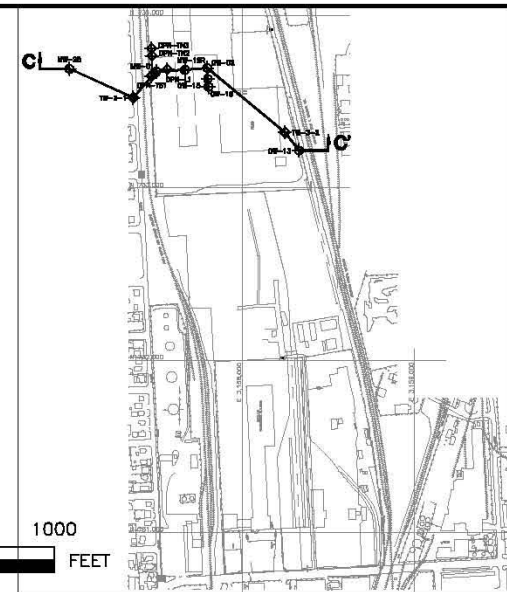
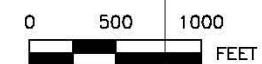
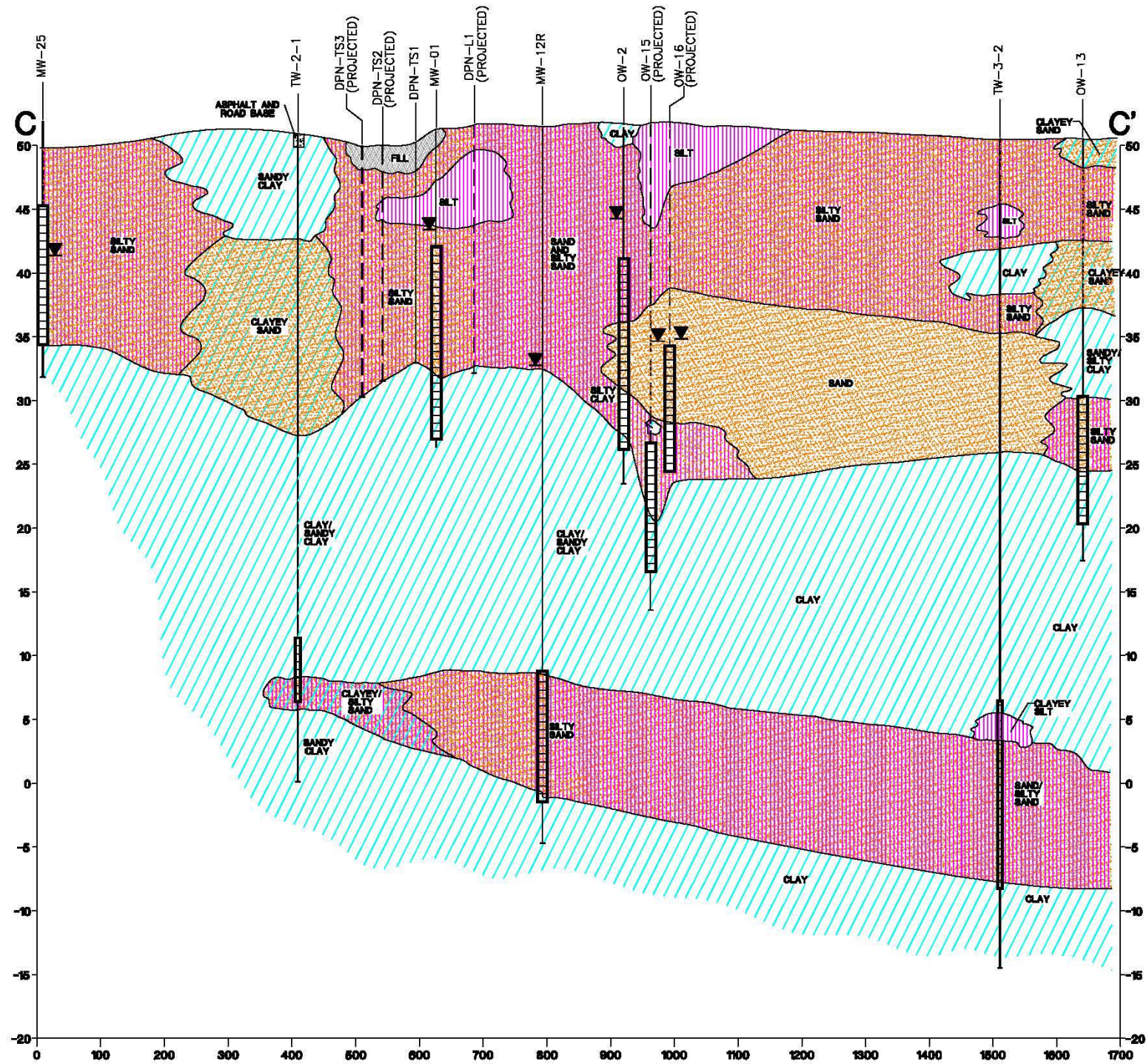
BEAZER EAST, INC.
PITTSBURGH, PENNSYLVANIA

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FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

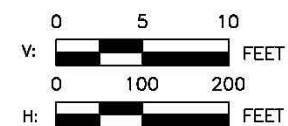
GEOLOGIC CROSS SECTION B-B'

PROJECT NO: 11-233
Figure



CROSS SECTION LOCATION LEGEND

- ASPHALT AND ROAD BASE
- FILL
- SAND
- CLAYEY SAND
- SILT, CLAYEY SILT, SANDY SILT
- SILTY SAND
- CLAY, SANDY CLAY, SILTY CLAY
- WATER LEVEL MEASURED
9/16 - 9/17 2005
- SOIL BORING LOCATION
- MONITORING WELL/SCREEN INTERVAL LOCATION
- TEMPORARY WELL/SCREEN INTERVAL LOCATION



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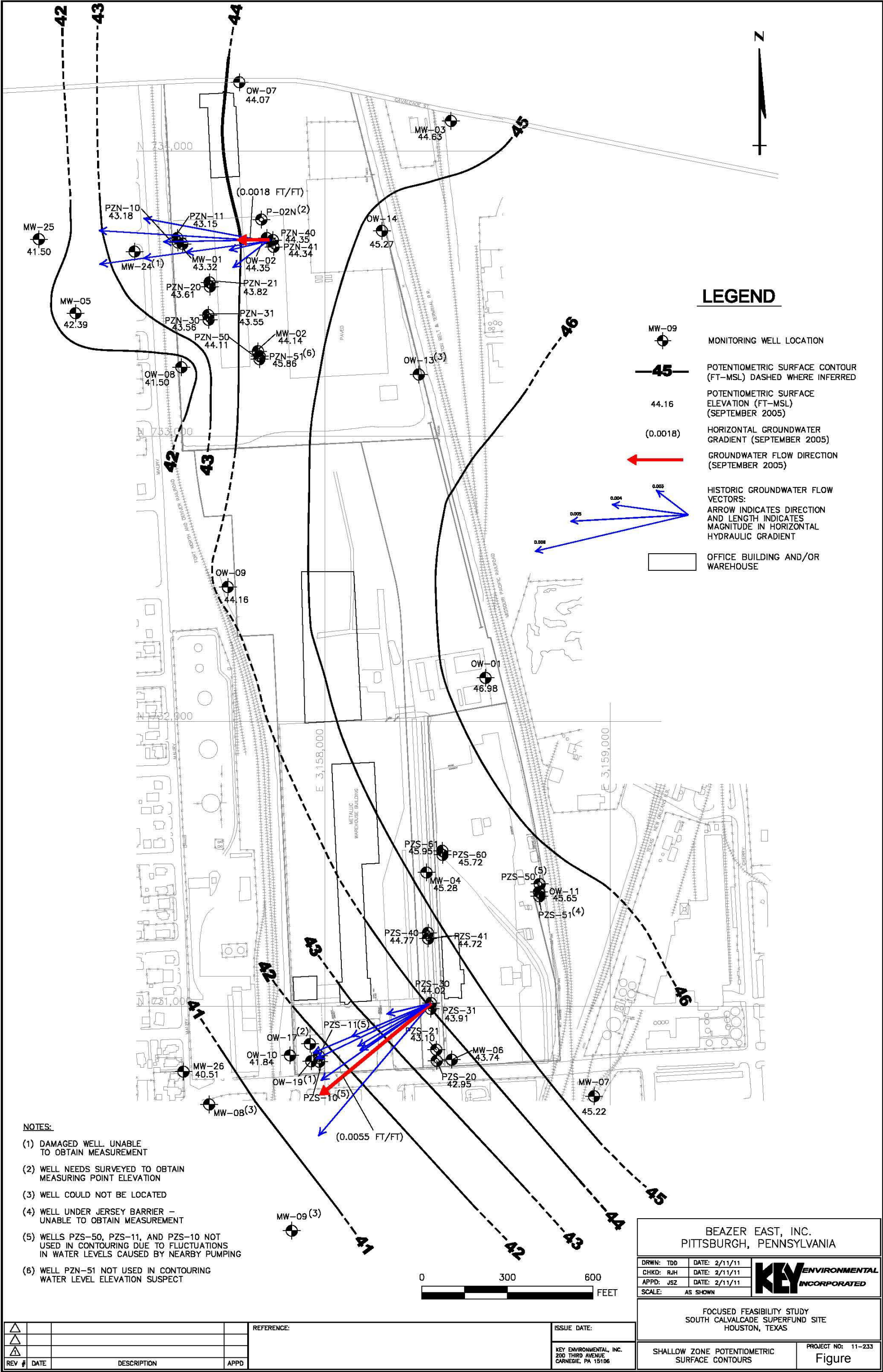
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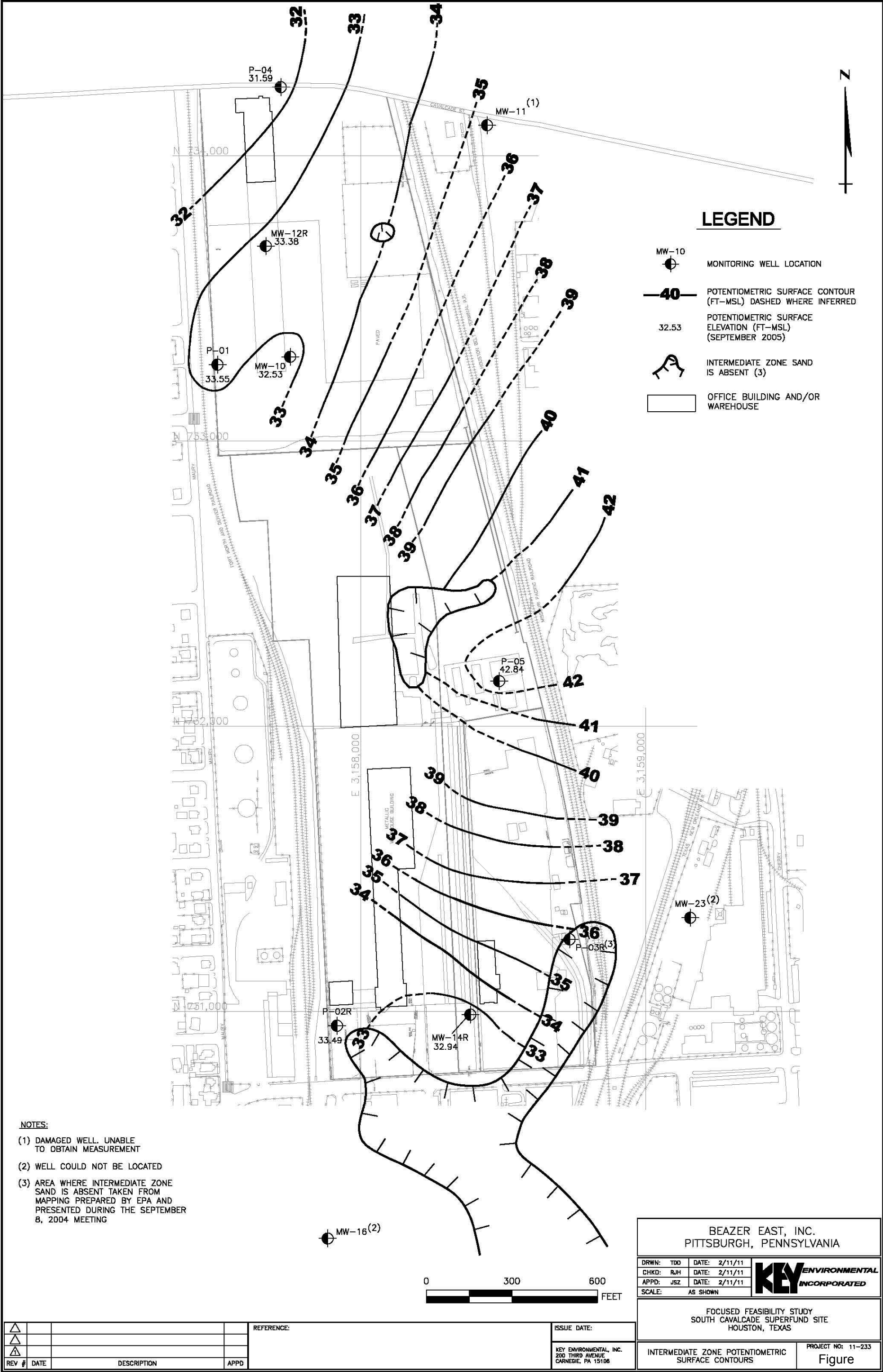
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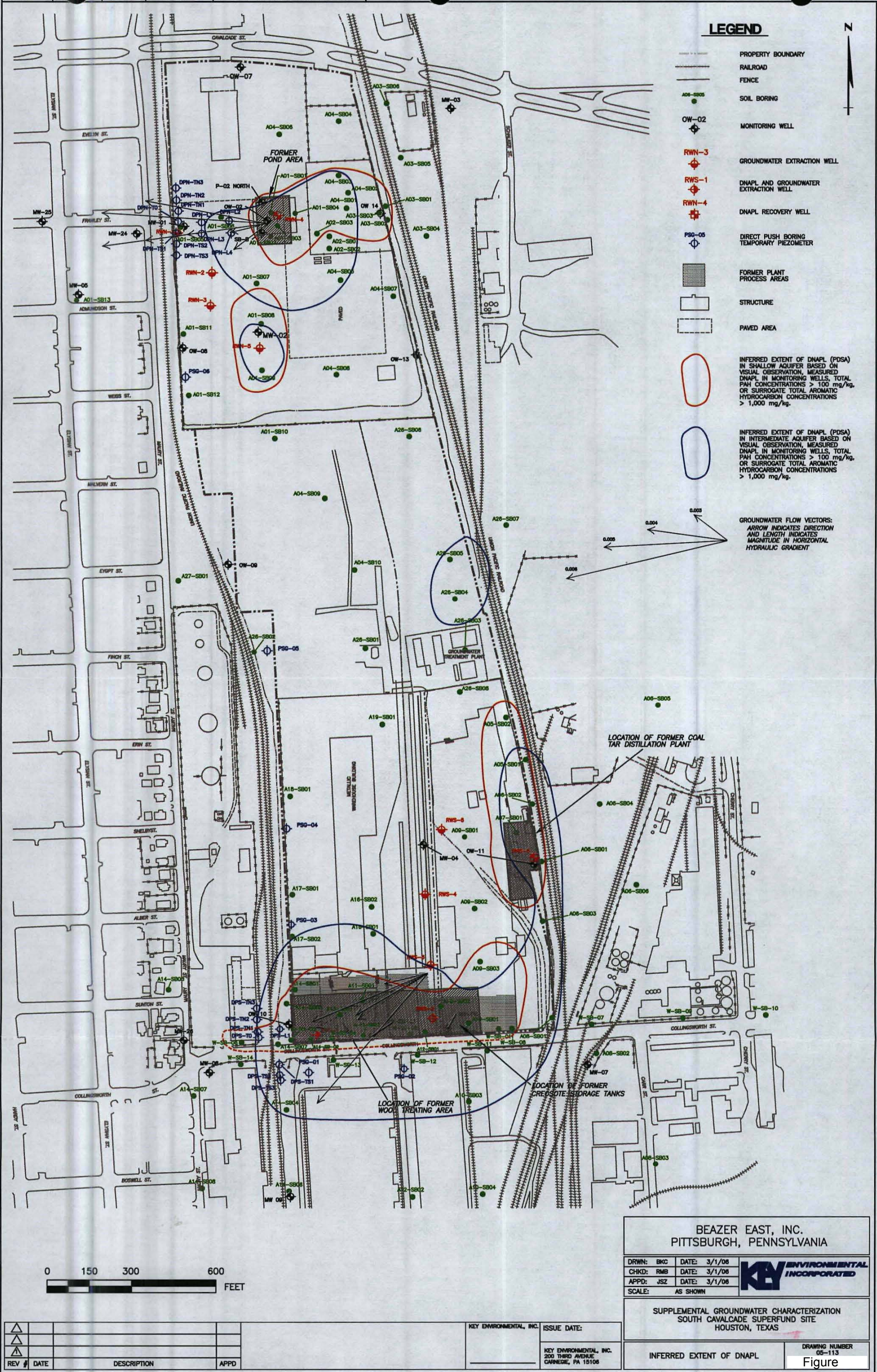
FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

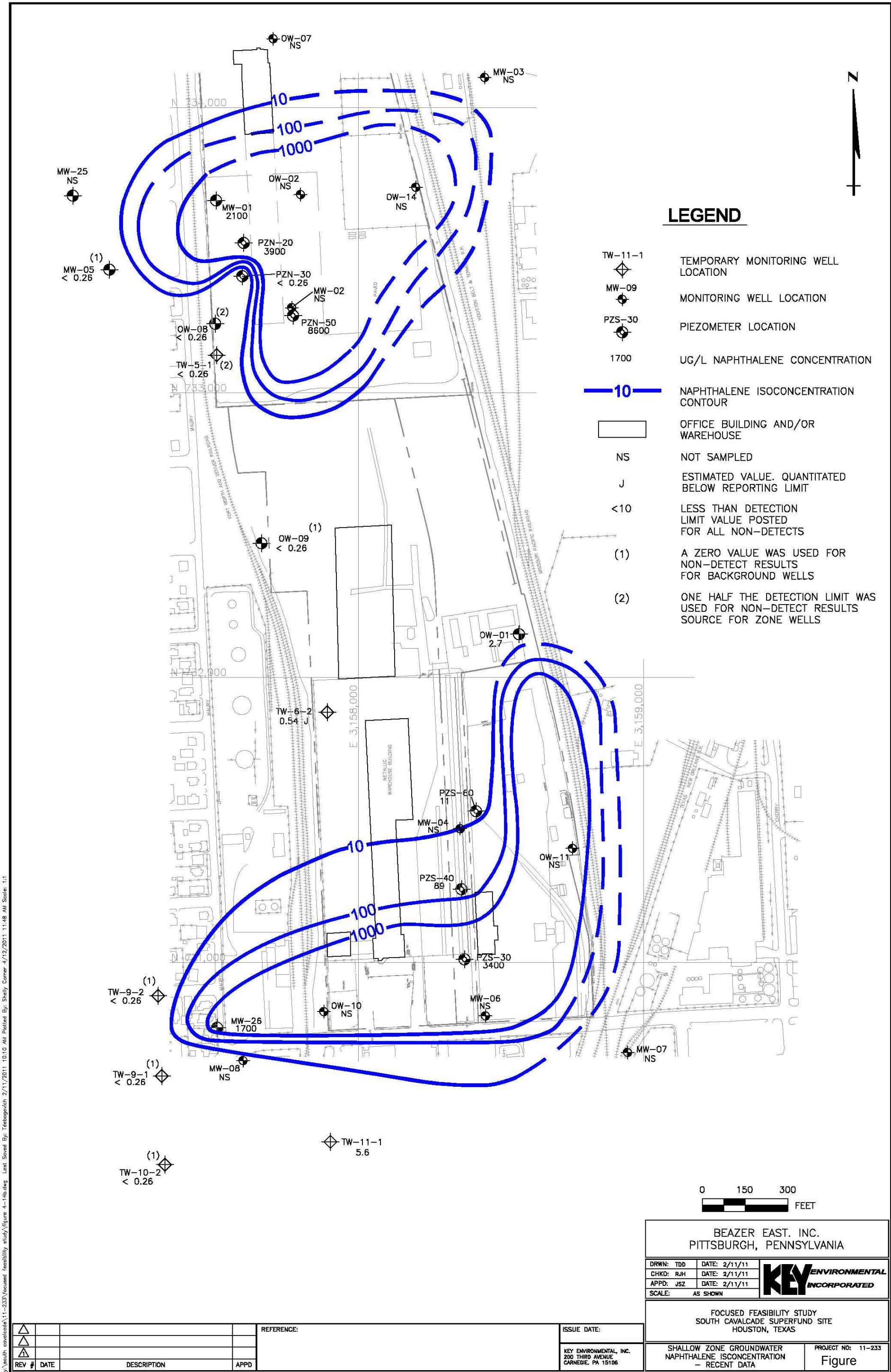
GEOLOGIC CROSS SECTION C-C'

PROJECT NO: 11-233
Figure

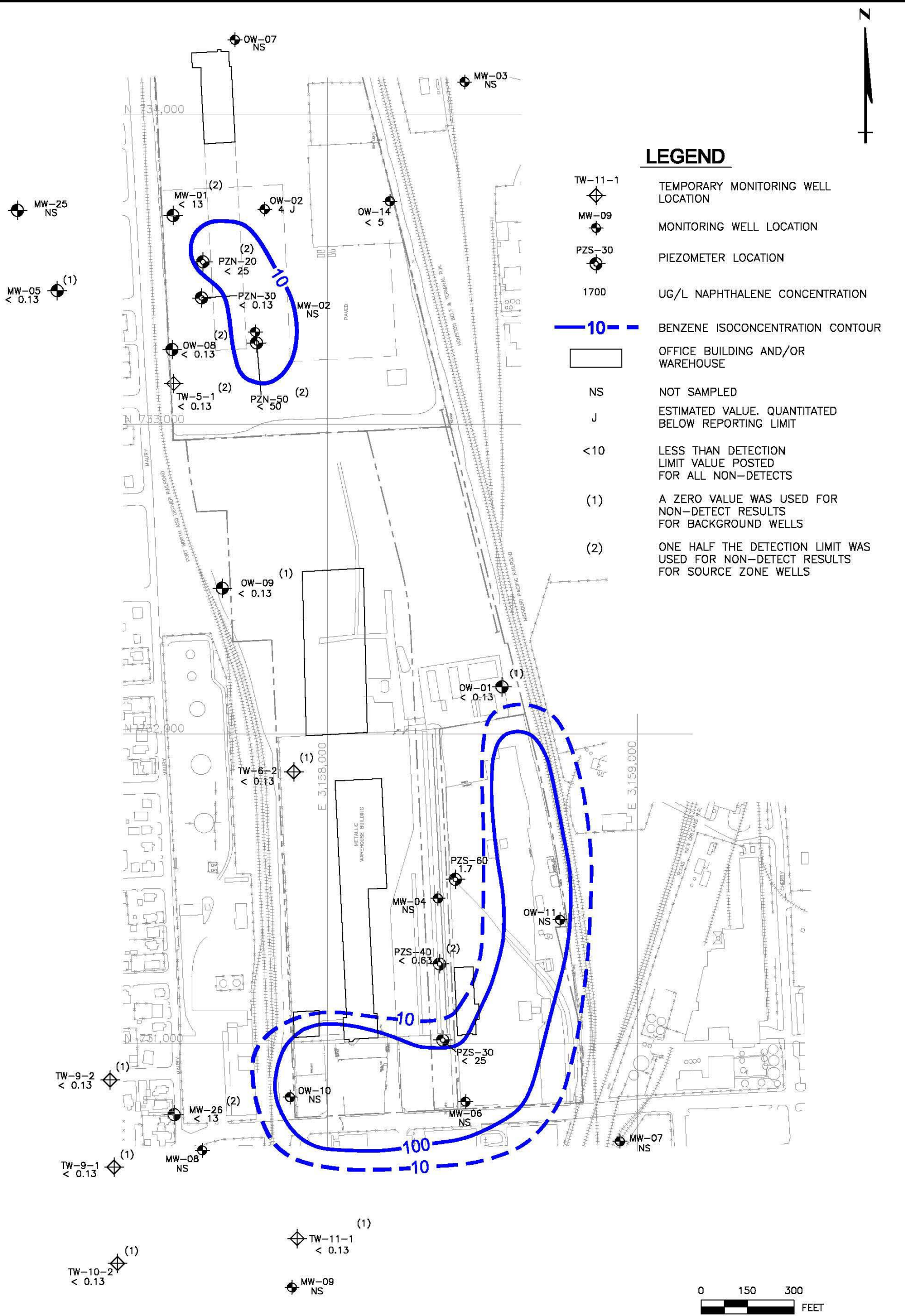








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CHKD: RJH	DATE: 2/11/11
APPD: JSZ	DATE: 2/11/11
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FOCUSSED FEASIBILITY STUDY SOUTH CAVALCADE SUPERFUND SITE HOUSTON, TEXAS	
SHALLOW ZONE GROUNDWATER BENZENE ISOCONCENTRATION - RECENT DATA	PROJECT NO: 11-233 Figure

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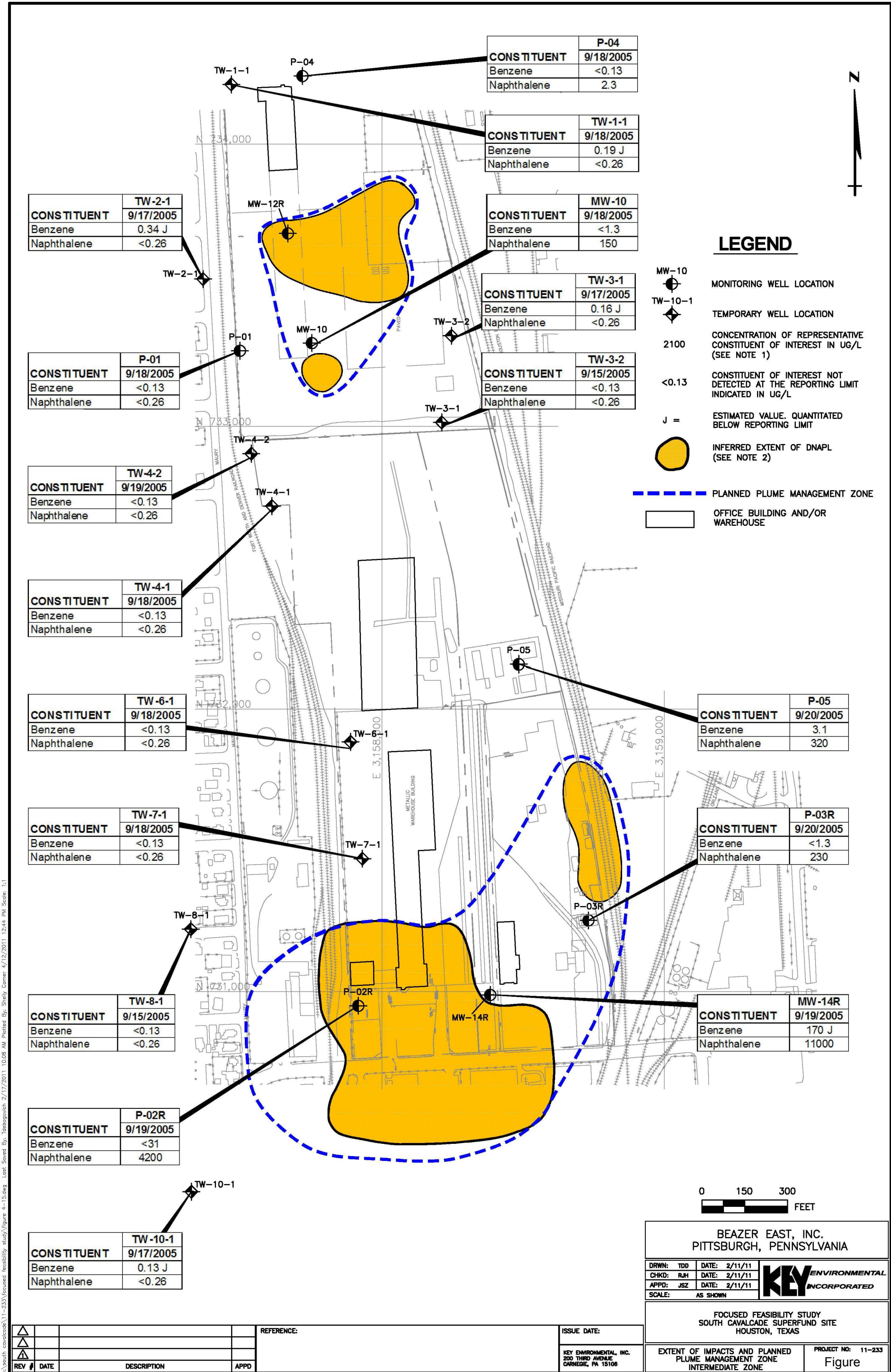


Table 1
Chronology of Site Events

Date	Event
1910	Wood Treating Plant Constructed
1944	Coal Tar Distillation Plant Constructed
1962	Wood Treating and Coal Tar Distillation Facilities Cease Operations
1983	Site Investigation by Houston Metro Transit Authority
April 1984	TDWR Recommends Site for Inclusion on the National Priorities List (NPL)
March 1985	Koppers Co. Enters into AOC with EPA to Perform a Remedial Investigation/Feasibility Study (RI/FS)
June 1986	Site Added to NPL
August 1988	RI/FS Completed
September 1988	Record of Decision (ROD) Issued
March 1991	Remedial Design/Remedial Action (RD/RA) Consent Decree Signed
March 1992	Remedial Design Workplan Completed
June 1992	Administrative Order on Consent Entered into with Property Owners
September 1992	Soil Delineation Report Approved by EPA
March 1993	Annual Sampling and Analysis of two Deep Monitoring Wells Initiated
December 1993	Pilot Studies for Soil Washing, Groundwater Collection and Groundwater Treatment are Completed
February 1994	Soil Remedy Evaluation Memorandum for In-Situ Bioremediation Issued
January 1995	EPA Approves Final Remedial Designs for the In-Situ Bioremediation Soil Remedy, DNAPL Recovery and Groundwater Collection System, and Groundwater Treatment System
May 1995	EPA Approves Remedial Action Work Plan (RAWP)
September 1995	Groundwater Collection and DNAPL Recovery System Installed, Groundwater Treatment Plant Upgrades Performed and Soil Delineation Completed
October 1995	Groundwater Collection Suspended/DNAPL Recovery System in Operation
January 1996	Groundwater Fate and Transport Evaluation Activities Initiated
June 1997	Amended ROD Issued with Reinforced Concrete Cap for Soil
August 1997	Final Ground Water Fate and Transport Evaluation Report (GFTER) Submitted to EPA/Texas Natural Resource Conservation Commission (TNRCC). TNRCC is now known as the Texas Commission on Environmental Quality (TCEQ).
August 1998	Final Work Plan for GFTER Verification Submitted to EPA/TNRCC
November 1999	Final Remedial Action Work Plan (RAWP) Issued
November 1999	EPA Approval of Soil Concrete Cap Design
November 1999	Soil Concrete Cap Construction Activities Initiated
November 1999	Work Plan for GFTER Verification is Implemented
May 2000	First Five-Year Review Site Inspection
July 2000	Concrete Cap Construction Completed, Final Inspection Held
July 2000	Verification of Ground Water Fate and Transport Evaluation Submitted for EPA/TNRCC Review
August 2000	Interim Remedial Action Report Submitted
September 2000	Preliminary Close Out Report Signed
August 2002	First Five-Year Review Site Inspection (Final)
September 2002	First Five-Year Review Finalized
August 2003	Final Verification of Groundwater Fate and Transport Evaluation Report Submitted to EPA in Response to Agency Comments Received April 2003
August 2005	EPA/TCEQ Approve a Supplemental Groundwater Investigation Work Plan

Table 1
Chronology of Site Events

Date	Event
March 2006	Supplemental Groundwater Investigation Report, Including Results of Comprehensive Groundwater Monitoring, Submitted to EPA/TCEQ
April 2006	RP Meets with EPA/TCEQ to Discuss Modification of Ground Water Remediation Goals via Submittal of Focused Feasibility Study (FFS)
April 2006	Groundwater Pumping Associated with DNAPL Recovery Operations Ceases After Power Surge (Lightning Strike) Damages Controller
April 2006-present	DNAPL recovery conductive in a passive mode without groundwater recovery
May 2007	Draft Focused Feasibility Study Report Submitted to EPA/TCEQ
June 2007	Second Five-Year Review Site Inspection
September 2007	Second Five-Year Review Finalized
April 2011	Final Focused Feasibility Study Report Submitted to EPA/TCEQ
May 2012	Third Five-Year Review Site Inspection

Table 2
Actions Taken Since the Last Five Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Action Taken and Outcome
1	Shallow rooted vegetation observed in the expansion joints along the eastern edge in the Southeast area.	Property owners Beazer	The Site inspection found shallow rooted vegetation is still growing in the expansion joints in this area. This continues to be an issue that needs to be addressed.
2	The list of owners for the Site needs to be updated and ensure that the AOC is still effective for ICs.	EPA Property owners	EPA has conducted a review of the deed records for properties at the Site to verify that the AOC is still effective for ICs. That review was unable to determine the ownership of the Northern Area of the Site.
3	Groundwater collection and DNAPL recovery system may no longer be the best remedial alternative.	Beazer/EPA/ TCEQ	Key Environmental submitted the Final Focused Feasibility Study for the Site on April 14, 2011, and the document is under review by EPA and TCEQ. EPA has requested additional information in support of the Study.
4	The Toll Road extension and Collingsworth Street expansion may impact the Site.	EPA HCTRA	There is no construction occurring on these projects in the vicinity of the Site. EPA has discussed these projects with HCTRA and the City of Houston and has requested that they be kept informed of the project status. EPA has not been provided any current designs on these projects.
5	Unavailability of plat and survey in public records	EPA	The status of this recommendation is unknown. Addition investigation is needed to determine whether the plat and survey have been placed in the public records.

Table
South Cavalcade
Analytical Summary 1995 -2011
Annual Deep Well Groundwater Sampling
South Cavalcade, Texas



Sample Location: Sample Date:	DW-02 Mar-95	LCW-01 Mar-95	DW-02 Apr-96	LCW-01 Apr-96	DW-02 Mar-97	DW-02 Sep-99	DW-02 Mar-00	DW-02 Mar-01	DW-02 Dec-02	DW-02 Dec-03	DW-02 Dec-04	DW-02 Dec-05	DW-02 Dec-06	DW-02 Dec-07	DW-02 Dec-08	DW-02 Dec-09	DW-02 Dec-10	DW-02 Apr-11
METHOD																		
BENZO(A)PYRENE	UG/L	0.02 U	0.02 U	0.02 U	0.02 U	0.054 U	0.02 UJ	0.02 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
BENZO(A)ANTHRACENE	UG/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
BENZO(B)FLUORANTHENE	UG/L	0.02 U	0.02 U	0.02 U	0.02 U	0.053 U	0.02 UJ	0.02 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
BENZO(K)FLUORANTHENE	UG/L	0.02 U	0.02 U	0.02 U	0.02 U	0.046 U	0.02 U	0.02 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
CHRYSENE	UG/L	0.15 U	0.15 U	0.15 U	0.20 U	0.150 U	0.15 U	0.15 U	2.20 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
DIBENZO(A,H)ANTHRACENE	UG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U
INDENO(1,2,3-CD)PYRENE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.22 U	0.20 U	0.19 U	0.19 U	0.19 U	0.20 U	0.20 U	0.19 U	0.20 U	0.19 U

Notes:

U indicates compound was analyzed for, but not detected.
In 1998, neither well LCW-01 nor well DW-02 were sampled.

TABLE 4
SUMMARY OF LONG-TERM MONITORING RESULTS FOR SHALLOW ZONE GROUNDWATER - SOUTH AREA
FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Monitoring Well	Location Relative to Source Zone	Site Constituent	Concentration (ug/L)									Trend Assessment	Assessment Basis
			Feb-83	Dec-86	Feb-87	Nov-93	Dec-93	Dec-99	Apr-00	Jul-00	Sep-05		
MW-06	Within	Benzene	-	930	-	780	-	-	-	-	-	Decreasing or stable	Qualitative
		Naphthalene	-	820000	35000	16000	-	-	-	-	-	Decreasing; typical source concentrations	Qualitative
OW-10	Within	Benzene	-	290	380	760	-	650	-	-	-	Increasing; low source zone concentrations	Mann-Kendall
		Naphthalene	-	66000	8100	15000	-	24000 E	-	-	-	No Trend; stable; typical source concentrations	Mann-Kendall
OW-11	Within	Benzene	-	500 J	300	65	-	-	-	-	-	Decreasing; low source zone concentrations	Qualitative
		Naphthalene	-	7100000	19000	43000	-	-	-	-	-	Stable or decreasing; typical source concentrations	Qualitative
MW-07	Upgradient	Benzene	-	5000 U	-	-	-	1 U	-	-	0.1 U	Non-detectable	Lab results
		Naphthalene	-	10 U	50 U	-	-	0.72 J	-	-	0.72	No trend; non-stable; below or near detection limit	Mann-Kendall
MW-04	Downgradient	Benzene	-	50 J	-	12	-	-	-	-	-	Decreasing	Qualitative
		Naphthalene	-	540	280	460	-	-	-	-	-	Stable	Qualitative
MW-08	Downgradient	Benzene	-	5 U	-	-	-	1 U	-	-	-	Non-detectable	Lab results
		Naphthalene	-	24	2 J	-	-	7.3 J	-	-	-	Stable; near detection limit	Qualitative
MW-26	Downgradient	Benzene	-	-	-	-	-	-	0.1 U	-	13 U	Non-detectable	Lab results
		Naphthalene	-	-	-	-	-	-	4300 D	-	1700	Decreasing or stable	Qualitative
PZS-30	Downgradient	Benzene	-	-	-	-	-	-	-	-	24 U	Non-detectable	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	3400	Typical near-source concentration	Lab result
PZS-40	Downgradient	Benzene	-	-	-	-	-	-	-	-	0.63 U	Non-detectable	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	89	Moderate on-site detection	Lab result
PZS-60	Downgradient	Benzene	-	-	-	-	-	-	-	-	1.7	Near detection limit	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	11	Near detection limit	Lab result
MW-09	Crossgradient	Benzene	-	5 U	-	-	-	-	-	-	-	Non-detectable	Lab result
		Naphthalene	-	40 U	13 J	-	-	-	-	-	-	Below or near detection limit	Lab results
OW-01	Crossgradient	Benzene	104	5 U	-	2.0 U	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	670	11 J	10 J	2 J	-	-	-	-	2.7	Decreasing; near detection limit	Mann-Kendall

D - Result is based on a diluted sample run.
E - Reported result is an estimate - outside linear calibration range of instrument.
J - Reported value is an estimate - quantitated below the Practical Quantitation Limit.
U - Constituent not detected at the reporting limit indicated.

TABLE 5
SUMMARY OF LONG TERM MONITORING RESULTS FOR SHALLOW ZONE GROUNDWATER - NORTH AREA
FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Monitoring Well	Location Relative to Source Zone	Site Constituent	Concentration (ug/L)									Trend Assessment	Assessment Basis
			Feb-83	Dec-86	Feb-87	Nov-93	Dec-93	Dec-99	Apr-00	Jul-00	Sep-05		
MW-02	Within	Benzene	-	90	77	-	-	-	-	-	-	Low source zone concentrations	Lab results
		Naphthalene	-	1100	1400	-	-	-	-	-	-	Low source zone concentrations	Lab results
OW-02	Within	Benzene	21	500 U	4 J	-	-	16	-	-	-	Stable; low source zone concentrations	Qualitative
		Naphthalene	17000	20000	13000	-	-	11000 D	-	-	-	Decreasing; typical source concentrations	Mann-Kendall
PZN-50	Within	Benzene	-	-	-	-	-	-	-	-	50 U	Non-detectable	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	8600	Typical source concentration	Lab result
OW-14	Within	Benzene	-	5 U	5 U	2.0 U	-	-	-	-	-	Non-detectable	Lab results
		Naphthalene	-	8200	2600	2900	-	-	-	-	-	Decreasing or stable; typical source concentrations	Qualitative
MW-03	Upgradient	Benzene	-	5 U	5 U	-	-	1 U	-	-	-	Non-detectable	Lab results
		Naphthalene	-	10 U	10 U	-	-	20	-	-	-	Stable; below or near detection limit	Qualitative
MW-01	Downgradient	Benzene	-	2 J	15	5.7	-	-	4.1	-	13 U	No trend; Stable	Mann-Kendall
		Naphthalene	-	3100	3400	1600	-	-	340	-	2100	No trend; Stable	Mann-Kendall
MW-05	Downgradient	Benzene	-	5 U	-	-	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	-	10 U	-	-	-	-	-	-	0.26 U	Non-detectable	Lab results
MW-24	Downgradient	Benzene	-	-	-	-	-	1.8	-	-	-	Near detection limit	Lab result
		Naphthalene	-	-	-	-	-	630 D	-	-	-	Typical near-source concentration	Lab result
MW-25	Downgradient	Benzene	-	-	-	-	-	-	2.6	0.13 U	0.13 U	Below or near detection limit	Lab results
		Naphthalene	-	-	-	-	-	-	0.36 U	0.26 U	0.26 U	Non-detectable	Lab results
OW-08	Downgradient	Benzene	-	5 U	-	-	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	-	1 J	20 U	-	-	-	-	-	0.26 U	Below or near detection limit	Lab results
PZN-20	Downgradient	Benzene	-	-	-	-	-	-	-	-	25 U	Non-detectable	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	3900	Typical near-source concentration	Lab result
PZN-30	Downgradient	Benzene	-	-	-	-	-	0.1 U	-	-	0.13 U	Non-detectable	Lab result
		Naphthalene	-	-	-	-	-	-	-	-	0.26 U	Non-detectable	Lab result
OW-07	Crossgradient	Benzene	-	5 U	5 U	2.0 U	1 U	-	-	-	-	Non-detectable	Lab results
		Naphthalene	-	10 U	50 U	1 J	6.9 J	-	-	-	-	No Trend; Non-Stable; below or near detection limits	Mann-Kendall
OW-09	Crossgradient	Benzene	-	5 U	-	-	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	-	10 U	10 U	-	-	-	-	-	0.26 U	Non-detectable	Lab results

D - Result is based on a diluted sample run.
J - Reported value is an estimate - quantitated below the Practical Quantitation Limit.
U - Constituent not detected at the reporting limit indicated.

TABLE 6
SUMMARY OF LONG-TERM MONITORING RESULTS FOR INTERMEDIATE ZONE GROUNDWATER - SITEWIDE
FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Monitoring Well	Location Relative to Source Zone	Site Constituent	Concentration (ug/L)									Trend Assessment	Assessment Basis
			Feb-83	Dec-86	Feb-87	Nov-93	Dec-93	Dec-99	Apr-00	Jul-00	Sep-05		
MW-14/14R	Within	Benzene	-	830	-	-	-	-	0.25 J	-	170	Decreasing	Qualitative
		Naphthalene	-	340000	70000	-	-	-	12000 D	-	11000	Decreasing	Mann-Kendall
MW-10	Within	Benzene	-	8 J	5 U	-	-	-	-	-	1.3 U	Non-detectable or near detection limit	Lab results
		Naphthalene	-	3400	690	-	-	-	-	-	150	Decreasing	Qualitative
MW-12/12R	Within	Benzene	-	500 U	-	-	-	-	1 U	-	-	Non-detectable or near detection limit	Lab results
		Naphthalene	-	7400	7710	-	-	-	1700 D	-	-	Decreasing; typical source concentrations	Qualitative
P-02/02R	Within	Benzene	-	70 J	-	-	-	-	8.4	-	31 U	Decreasing or Stable	Qualitative
		Naphthalene	-	6100	5200	-	-	-	1400 D	-	4200	Decreasing	Mann-Kendall
MW-11	Upgradient	Benzene	-	5 U	5 U	-	-	-	-	-	-	Non-detectable	Lab results
		Naphthalene	-	10 U	20 U	-	-	-	-	-	-	Non-detectable	Lab results
MW-23	Upgradient	Benzene	-	5 U	-	-	-	-	-	-	-	Non-detectable	Lab result
		Naphthalene	-	10 U	-	-	-	-	-	-	-	Non-detectable	Lab result
OW-13	Upgradient	Benzene	-	5 U	-	-	-	-	-	-	-	Non-detectable	Lab result
		Naphthalene	-	10 U	10 U	-	-	-	-	-	-	Non-detectable	Lab results
P-01	Downgradient	Benzene	-	5 U	-	-	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	-	10 U	20 U	-	-	-	-	-	0.26 U	Non-detectable	Lab results
P-05	Downgradient	Benzene	-	5 U	-	-	-	-	-	-	3.1	Below or near detection limit	Lab results
		Naphthalene	-	2400	20 U	-	-	-	-	-	320	Decreasing	Qualitative
P-03/03R	Downgradient	Benzene	-	800	-	-	-	-	2.9	-	1.3 U	Decreasing	Qualitative
		Naphthalene	-	140000	15000	-	-	-	0.36 U	-	230	Decreasing	Mann-Kendall
MW-16	Crossgradient	Benzene	-	5 U	5 U	-	-	-	-	-	-	Non-detectable	Lab results
		Naphthalene	-	20 U	20 U	-	-	-	-	-	-	Non-detectable	Lab results
P-04	Crossgradient	Benzene	-	5 U	-	-	-	-	-	-	0.13 U	Non-detectable	Lab results
		Naphthalene	-	10 U	20 U	-	-	-	-	-	2.3	Below or near detection limit	Lab results
DW-02	Deep	Benzene	-	5 U	-	-	-	-	-	-	-	Non-detectable	Lab result
DW-02	Deep	Naphthalene	-	10 U	10 U	-	-	-	-	-	-	Non-detectable	Lab results
OW-06	Deep	Benzene	10 U	5 J	5 U	-	-	-	-	-	-	Non-detectable or near detection limit	Lab results
OW-06	Deep	Naphthalene	10 U	10 U	4 J	-	-	-	-	-	-	Non-detectable or near detection limit	Lab results

D - Result is based on a diluted sample run.
J - Reported value is an estimate - quantitated below the Practical Quantitation Limit.
U - Constituent not detected at the reporting limit indicated.

TABLE 7
DNAPL THICKNESS MEASUREMENT SUMMARY
FOCUSED FEASIBILITY STUDY
SOUTH CAVALCADE SUPERFUND SITE
HOUSTON, TEXAS

Well	DNAPL Thickness (ft)			Date of Most Recent	Comments
	Minimum	Maximum	Most Recent		
SHALLOW ZONE WELLS					
RWS-1	0	10.93	0.02	12/18/2006	
RWS-2	0	3.59	2	12/18/2006	
RWN-4	0	11	0	8/30/2006	
RWS-5	0	2.73	0.05	11/29/2006	
PZS-10	0	6.67	0	10/17/2006	
PZS-20	0.083	13	3.96	10/17/2006	
PZN-40	0	-	0	10/17/2006	DNAPL noted during historical groundwater sampling
PZN-41	0	-	0	10/17/2006	DNAPL noted during historical groundwater sampling
PZS-50	0.08	0.62	0.26	10/17/2006	
PZS-51	0	0.25	0	10/17/2006	
OW-02	0	2.42	0.07	10/17/2006	
OW-10	0	-	0	10/17/2006	DNAPL noted during historical groundwater sampling
OW-11	0.683	0.98	0.1	10/17/2006	
P-02N	-	0.8	0.8	9/17/2005	One available measurement
MW-06	0	3	0	9/17/2005	
INTERMEDIATE ZONE WELLS					
OW-20	-	1.27	1.27	9/16/2005	One available measurement
MW-12R	-	2	2	9/17/2005	One available measurement
ITW-02	-	2.4	2.4	9/17/2005	One available measurement

Attachment 1

Documents Reviewed

ARCADIS U.S., Inc., April 2011. *Technical Memorandum - South Cavalcade Superfund Site Human Health Risk Assessment.*

ARCADIS U.S. Inc., April 2012. *Long-Term Operations and Maintenance Report (Soil Remedy), South Cavalcade Superfund Site – Concrete Cap.*

Beazer East, Inc., February 2012. *South Cavalcade Superfund Site Quarterly Progress Report #53.*

Dames & Moore, May 1995. Modifications incorporated November 1999. *Final Remedial Action Work Plan.*

EPA, September 1988. *Record of Decision South Cavalcade Street Site, Houston, Texas.*

EPA, May 1997. *Amended Record of Decision No. 1 South Cavalcade Street Site, Houston, Texas.*

EPA, June 2001. *Comprehensive Five-Year Review Guidance.* OSWER No. 9355.7-03B-P.

EPA, September 2002. *Five-Year Review South Cavalcade Street Site, Houston, Harris County Texas.*

EPA, September 2007. *Five-Year Review South Cavalcade Street Site, Houston, Harris County Texas.*

Field & Technical Services (FTS), May 2011. *Report of Findings - 2011 Deep Monitoring Well Sampling and Analysis - South Cavalcade Superfund Site Houston, Texas.*

Harris-Galveston Subsidence District (HGSD), February 2012. *Rules.*

Key Environmental, Inc., March 2006. *Supplemental Groundwater Investigation Report, South Cavalcade Superfund Site, Houston, Texas.*

Key Environmental Inc., April 2011. *Final Focused Feasibility Study South Cavalcade Superfund Site.*

Keystone Environmental Resources, Inc. 1988. *Feasibility Study South Cavalcade.*

Keystone Environmental Resources, Inc. 1988. *Remedial Investigation South Cavalcade.*

Attachment 2
Interview Record Forms

Five-Year Review Interview Record South Cavalcade Street Superfund Site Houston, Texas			Interviewee: Raji Josiam Phone: 214-665-8529 email: josiam.raji@epa.gov	
Site Name: South Cavalcade Street Superfund Site	EPA ID No. TXD980810386		Date of Interview 6/1/12	Interview Method Electronic
Interview Contacts	Organization	Phone	Email	Address
Raji Josiam	EPA Region 6	214-665-8529	josiam.raji@epa.gov	EPA Region 6 1445 Ross Ave Dallas, TX 75202-2733
John Hickman	U.S. Army Corps of Engineers	918-669-7142	john.a.hickman@usace.army.mil	Corps of Engineers 1645 S. 101 st E. Ave. Tulsa, OK 74128
Interview Questions (scope of the interview is from 2007 to present)				
<p>1. What is your overall impression of the work conducted at the site since 2007?</p> <p>Response:</p> <p>Overall Status</p> <ul style="list-style-type: none"> Discussions have taken place with City of Houston and Harris County Toll Road Authority regarding the toll road expansion. The EPA and the TCEQ have reviewed initial plans for the expansion in the vicinity of the site. Currently waiting to review their updated schedule and design plans for the expansion. Their work in the vicinity of the site would affect site operations. Discussions have taken place with Beazer, Key Environmental, the TCEQ, the EPA HQ, and the EPA Region 6 personnel regarding the remedial action alternatives for the northern portion and for the southern portion of the site. These alternatives are currently being evaluated given the site specific operations and conditions. Different questions have been raised during the discussions and in order to address these Beazer has been gathering information and has been evaluating remedial alternatives. This has been an involved process and in order to sufficiently address the questions raised the ROD Amendment timeline has been moved from 2012 to 2013. 				
<p>2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: Currently there are no active remedial operations at the site. The one community concern is the offsite plume in the southern portion of the site. A TI Waiver zone along with institutional controls needs to be established for the on-site and off-site plumes. No specific community concerns have brought to my attention regarding the operation and maintenance at this time. Recently there have been a few enquiries for the northern portion of the site where different trucking companies are interested in buying the property. These interested parties have all been provided with the due diligence documents that they need to follow.</p>				
<p>3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and</p>				

results.

Response: Yes as the need arises we have met at the site to discuss site operations. Recently in December 2011, there was a site visit by EPA HQ and EPA R6 personnel along with TCEQ, Beazer, Key Environmental, and GW Insight personnel to discuss remedial alternatives for the site. In May 2012 a site inspection was conducted by EPA R6 along with USACE, TCEQ, Beazer, and Key Environmental personnel. Also as citizens/operators/interested parties have called regarding the site, EPA R6 has been in communication with them.

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please give details.

Response: None that I am aware of.

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and result.

Response: No complaints, violations, or other incidents were received related to the site that required a response by our office.

6. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures? If so, please describe changes and impacts.

Response: The pump and treat remedial action has been suspended and alternative remedial actions are currently being evaluated for the site and will be documented in a ROD amendment.

7. Have there been any changes in state or federal environmental standards since 2007 which may call into question the protectiveness or effectiveness of the remedial action?

Response: Not aware of any.

8. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site since 2007, and have such changes been implemented?

Response: Optimization opportunities have not been identified at this time.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: The ROD Amendment scheduled to be issued in 2013 will address the remedial actions for the site.

Five-Year Review Interview Record South Cavalcade Street Superfund Site Houston, Texas			Interviewee: Fay Duke Phone: 512.239.2443 email: fay.duke@tceq.texas.gov	
Site Name: South Cavalcade Street Superfund Site	EPA ID No. TXD980810386		Date of Interview 5/31/2012	Interview Method Email
Interview Contacts	Organization	Phone	Email	Address
Raji Josiam	EPA Region 6	214-665-8529	josiam.raji@epa.gov	EPA Region 6 1445 Ross Ave Dallas, TX 75202-2733
John Hickman	U.S. Army Corps of Engineers	918-669-7142	john.a.hickman@usace.army.mil	Corps of Engineers 1645 S. 101 st E. Ave. Tulsa, OK 74128
Interview Questions (scope of the interview is from 2007 to present)				
<p>1. What is your overall impression of the work conducted at the site since 2007?</p> <p>Response: The caps appeared to be well maintained and functioning as intended. The staff from the TCEQ, EPA and performing parties has been working on amending the remedy since the suspension of the groundwater pumping associated with the recovery of the dense non-aqueous phase liquid (DNAPL). The process is very slow. Although affected groundwater above protective levels has migrated off-site, there appears to be no current exposure pathway. However, additional water well surveys or groundwater sampling should be conducted to confirm the findings. Additionally, institutional control should also be implemented to ensure no exposure.</p>				
<p>2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?</p> <p>Response: The TCEQ is unaware of any ongoing community concerns.</p>				
<p>3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.</p> <p>Response: There are no routine activities required to be performed by the TCEQ.</p>				
<p>4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please give details.</p> <p>Response: The TCEQ is unaware of such incidents.</p>				
<p>5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and result.</p>				

Response: I am not aware of any problems requiring response by TCEQ.

6. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures? If so, please describe changes and impacts.

Response: The construction of the new extension of the toll road has the potential to impact the effectiveness of the remedial action. However, the Harris County Toll Road Authority is aware of the Superfund site, its impact on toll road project and is working to ensure no impact to the effectiveness of the implemented remedy.

7. Have there been any changes in state or federal environmental standards since 2007 which may call into question the protectiveness or effectiveness of the remedial action?

Response: The change in the remedy would need to ensure that it complies with all state and federal environmental standards.

8. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site since 2007, and have such changes been implemented?

Response: The performing parties need to ensure that the monitoring wells for the deeper groundwater zone are maintained and repaired. Additional sampling and monitoring of the off-site shallow groundwater plume should be sampled on a routine basis to ensure no migration and no exposure.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes. EPA RPM and Performing Party provide TCEQ with updates through conference calls and meetings.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: The performing party should complete the FFS evaluation to address EPA HQ concerns. Where no active restorations are planned for the affected groundwater offsite, institutional controls must be implemented restricting the use of the groundwater.

Five-Year Review Interview Record South Cavalcade Street Superfund Site Houston, Texas		Interviewee: James Zubrow Phone: (412) 279-3363 email: jzubrow@keyenvir.com		
Site Name: South Cavalcade Street Superfund Site	EPA ID No. TXD980810386		Date of Interview June 1, 2011	Interview Method Form
Interview Contacts	Organization	Phone	Email	Address
Raji Josiam	EPA Region 6	214-665-8529	josiam.raji@epa.gov	EPA Region 6 1445 Ross Ave Dallas, TX 75202-2733
John Hickman	U.S. Army Corps of Engineers	918-669-7142	john.a.hickman@usace.army.mil	Corps of Engineers 1645 S. 101 st E. Ave. Tulsa, OK 74128
Interview Questions (scope of the interview is from 2007 to present)				
1. What is your overall impression of the work conducted at the site since 2007?				
Response: We have made substantial progress towards amending the ROD for the groundwater remedy by the completion of the Focused Feasibility Study, Technical Impracticability Demonstration Report, Natural Attenuation Technical Memorandum and the Human Health Risk Assessment Technical Memorandum.				
2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?				
Response: The remedial operations have not adversely impacted the surrounding community. I am not aware of any ongoing community concerns regarding the site or the operations and maintenance activities.				
3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.				
Response: Beazer's nationwide Operations and Maintenance contractor, Field & Technical Services, LLC (FTS), visits the Site once per month to gauge the DNAPL recovery wells for the presence/absence of DNAPL. These activities are documented in quarterly progress reports submitted to EPA and TCEQ. The completed soil remedy is inspected by an engineer on an annual frequency. The engineer prepares a report to document the inspection and submits the report to the agencies. Neither the monthly O&M visits, nor the annual cover inspections, have identified any major issues requiring actions.				

4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please give details.

Response:

No. I am not aware of any vandalism or other unauthorized activities occurring at the Site. In this regard, it is helpful that the site is occupied by the trucking businesses as I am sure this deters trespassing.

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and result.

Response: No.

6. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures? If so, please describe changes and impacts.

Response: There have not been any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures during this five-year review period.

7. Have there been any changes in state or federal environmental standards since 2007 which may call into question the protectiveness or effectiveness of the remedial action?

Response: No.

8. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site since 2007, and have such changes been implemented?

Response: We have not proposed it to EPA at this time, but I believe the frequency of the O&M visits could be reduced without any adverse consequences whatsoever.

9. Do you feel well-informed about the site's activities and progress?

Response: Yes.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response:

Nothing more than what is provided above.

Five-Year Review Interview Record South Cavalcade Street Superfund Site Houston, Texas		Interviewee: Mike Phone: email:		
Site Name: South Cavalcade Street Superfund Site	EPA ID No. TXD980810386		Date of Interview 5/16/201	Interview Method mai
Interview Contacts	Organization	Phone	Email	Address
Raji Josiam	EPA Region 6	214-665-8529	josiam.raji@epa.gov	EPA Region 6 1445 Ross Ave Dallas, TX 75202-2733
John Hickman	U.S. Army Corps of Engineers	918-669-7142	john.a.hickman@usace.army.mil	Corps of Engineers 1645 S. 101 st E. Ave. Tulsa, OK 74128
Interview Questions (scope of the interview is from 2007 to present)				
1. What is your overall impression of the work conducted at the site since 2007?				
Response: GOOD				
2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?				
Response: NO ISSUE, NOT REPAIRED manhole cover				
3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.				
Response: NO				
4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please give details.				
Response: NO				

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and result.

Response: NO

6. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures? If so, please describe changes and impacts.

Response: NO

7. Have there been any changes in state or federal environmental standards since 2007 which may call into question the protectiveness or effectiveness of the remedial action?

Response: NO

8. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site since 2007, and have such changes been implemented?

Response: NO

9. Do you feel well-informed about the site's activities and progress?

Response: YES

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: NO

Five-Year Review Interview Record South Cavalcade Street Superfund Site Houston, Texas		Interviewee: Mike Perez Phone: (713) 587-7903 email: mike.perez@hctra.org		
Site Name: South Cavalcade Street Superfund Site	EPA ID No. TXD980810386		Date of Interview June 27, 2012	Interview Method email
Interview Contacts	Organization	Phone	Email	Address
Raji Josiam	EPA Region 6	214-665-8529	josiam.raji@epa.gov	EPA Region 6 1445 Ross Ave Dallas, TX 75202-2733
John Hickman	U.S. Army Corps of Engineers	918-669-7142	john.a.hickman@usace.army.mil	Corps of Engineers 1645 S. 101 st E. Ave. Tulsa, OK 74128
Interview Questions (scope of the interview is from 2007 to present)				
1. What is your overall impression of the work conducted at the site since 2007?				
Response: The EPA has continued to monitor the site.				
2. From your perspective, what effect have remedial operations at the site had on the surrounding community? Are you aware of any ongoing community concerns regarding the site or its operation and maintenance?				
Response: Not aware of any.				
3. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.				
Response: EPA There has been ongoing communication between EPA and HCTRA over the past several years. HCTRA's contractor has collected soil samples within the superfund site as part of the preparation of a Materials Management Plan to be implemented during the Toll Road's construction project(s). This information has been shared with EPA.				
4. Are you aware of any events, incidents, or activities that have occurred at the site such as dumping, vandalism, or anything that required emergency response from local authorities? If so, please give details.				
Response: No.				

5. Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and result.

Response: No.

6. Are you aware of any problems or difficulties encountered which impacted the effectiveness of the remedial action, or a change in O&M procedures? If so, please describe changes and impacts.

Response: No.

7. Have there been any changes in state or federal environmental standards since 2007 which may call into question the protectiveness or effectiveness of the remedial action?

Response: Not to my knowledge.

8. Do you know of opportunities to optimize the operation, maintenance, or sampling efforts at the site since 2007, and have such changes been implemented?

Response: Not to my knowledge.

9. Do you feel well-informed about the site's activities and progress?

Response: EPA has kept the Toll Road informed regarding the site activities.

10. Do you have any comments, suggestions, or recommendations regarding the site?

Response: No.

Attachment 3

Five-Year Review Site Inspection Checklist

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION			
Site name: South Cavalcade Street Superfund Site		Date of inspection: May 16, 2012	
Location and Region: Houston, Texas		EPA ID: TXD980810386	
Agency, office, or company leading the five-year review: USACE		Weather/temperature: scattered clouds, upper 70's	
Remedy Includes: (Check all that apply) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <input checked="" type="checkbox"/> Landfill cover/containment <input checked="" type="checkbox"/> Access controls <input checked="" type="checkbox"/> Institutional controls <input checked="" type="checkbox"/> Groundwater pump and treatment <input checked="" type="checkbox"/> Surface water collection <input checked="" type="checkbox"/> Other: The soil remedy was a constructed concrete cap over soils designed for truck parking for the businesses on-site. </div> <div style="width: 45%;"> <input checked="" type="checkbox"/> Monitored natural attenuation <input checked="" type="checkbox"/> Groundwater containment <input type="checkbox"/> Vertical barrier walls </div> </div>			
Attachments: <input checked="" type="checkbox"/> Inspection team roster attached <input checked="" type="checkbox"/> Site map attached			
II. INTERVIEWS (Check all that apply)			
1. O&M site manager	Mike Bollinger <div style="text-align: center;">Name</div>	Environmental Manager <div style="text-align: center;">Title</div>	<div style="text-align: center;">Date</div>
Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no. (412) 208-8864 Problems, suggestions: Mr. Bollinger has not yet returned the interview form.			
2. O&M staff	Jim Zubrow <div style="text-align: center;">Name</div>	Principal Hydrologist <div style="text-align: center;">Title</div>	June 1, 2012 <div style="text-align: center;">Date</div>
Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input checked="" type="checkbox"/> email form Phone no. (412) 279-3363 Problems, suggestions: See attached interview form.			

3.	Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.				
Agency	EPA				
Contact	Raji Josiam	Remedial Project Manager	6/1/2012	(214) 665-8529	
	Name	Title	Date	Phone no.	
Problems; suggestions: See attached interview form.					
Agency	TCEQ				
Contact	Fay Duke	Project Manager	5/31/2012	(512) 239-2443	
	Name	Title	Date	Phone no.	
Problems; suggestions:					
Agency	City of Houston				
Contact	Ceil Price	Senior Assistant City Attorney		(832) 393-6291	
	Name	Title	Date	Phone no.	
Problems; suggestions; Ms. Price has not returned the interview form yet.					
Agency					
Contact					
	Name	Title	Date	Phone no.	
Problems; suggestions;					
<hr/>					
4.	Other interviews (optional) ✓ Report attached.				
Mike King, Palletized Trucking					

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	O&M Documents <input checked="" type="checkbox"/> O&M manual <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input checked="" type="checkbox"/> As-built drawings <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input checked="" type="checkbox"/> O&M logs <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: _____ 			
2.	Site-Specific Health and Safety Plan <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Contingency plan/emergency response plan <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: _____ 			
3.	O&M and OSHA Training Records <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: _____ 			
4.	Permits and Service Agreements <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Effluent discharge <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A <input type="checkbox"/> Other permits _____ <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: The NPDES permit expired in October 1998. The treatment and discharge of groundwater ceased in April 2006. 			
5.	Gas Generation Records <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A Remarks: _____ 			
6.	Settlement Monument Records <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A Remarks: _____ 			
7.	Groundwater Monitoring Records <input checked="" type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> N/A Remarks: Monitoring of the deep aquifer is conducted annually and the results submitted are to EPA. There is no established groundwater monitoring plan being followed for the shallow and intermediate aquifers. The analysis of the samples that are collected do not include analyses for all of the groundwater constituents that have remedial goals. The most recent results from groundwater sampling in March 2011 have not been provided to EPA yet. 			
8.	Leachate Extraction Records <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A Remarks: _____ 			
9.	Discharge Compliance Records <input type="checkbox"/> Air <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/> Water (effluent) <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input checked="" type="checkbox"/> N/A Remarks: The treatment and discharge of groundwater ceased in April 2006. Discharge records are no longer kept, or submitted to EPA. 			

10.	Daily Access/Security Logs	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
Remarks: All of the Site is fenced except for the southwest cap, which is on the property occupied by Jevic Transportation. The access to the southern area is restricted to authorized employees of the trucking companies. Although American Warehouse south of the Site on Collingsworth Street keeps a security log of visitors to their property, no other logs were observed on the Site visit. The northern area is fenced and unoccupied and access is restricted to Beazer and their contractors.				

IV. O&M COSTS																																																					
1.	O&M Organization <input type="checkbox"/> State in-house <input checked="" type="checkbox"/> PRP in-house <input type="checkbox"/> Federal Facility in-house Remarks:	<input type="checkbox"/> Contractor for State <input checked="" type="checkbox"/> Contractor for PRP <input type="checkbox"/> Contractor for Federal Facility																																																			
2.	O&M Cost Records <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> Funding mechanism/agreement in place <input type="checkbox"/> Original O&M cost estimate <input type="checkbox"/> Breakdown attached <div style="text-align: center;">Total annual cost by year for review period if available</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">From</td> <td style="width: 15%;"><input type="checkbox"/> Breakdown attached</td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td></td> <td>Total cost</td> </tr> <tr> <td>From</td> <td><input type="checkbox"/> Breakdown attached</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td></td> <td>Total cost</td> </tr> <tr> <td>From</td> <td><input type="checkbox"/> Breakdown attached</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td></td> <td>Total cost</td> </tr> <tr> <td>From</td> <td><input type="checkbox"/> Breakdown attached</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td></td> <td>Total cost</td> </tr> <tr> <td>From</td> <td><input type="checkbox"/> Breakdown attached</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td></td> <td>Total cost</td> </tr> </table> <div style="margin-top: 10px;">Remarks: O&M costs were not provided to the review team by Beazer.</div>			From	<input type="checkbox"/> Breakdown attached					Date	Date		Total cost	From	<input type="checkbox"/> Breakdown attached					Date	Date		Total cost	From	<input type="checkbox"/> Breakdown attached					Date	Date		Total cost	From	<input type="checkbox"/> Breakdown attached					Date	Date		Total cost	From	<input type="checkbox"/> Breakdown attached					Date	Date		Total cost
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	Date	Date		Total cost																																																	
3.	Unanticipated or Unusually High O&M Costs During Review Period Describe costs and reasons:																																																				
V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A																																																					
A. Fencing																																																					
1.	Fencing damaged <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Gates secured <input type="checkbox"/> N/A Remarks: The fences were in good condition.																																																				

B. Other Access Restrictions			
1.	Signs and other security measures	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A
Remarks: The southern area of the Site is fenced and occupied by two trucking companies that maintain security for the area. The northern area is fenced but unoccupied.			

C. Institutional Controls (ICs)				
1.	Implementation and enforcement			
	Site conditions imply ICs not properly implemented	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> N/A
	Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> N/A
Type of monitoring: Beazer provides quarterly reports to EPA of Site activities. EPA verifies the conditions of the ICs are being met.				
Frequency: Quarterly.				
Responsible party/agency: Beazer/EPA				
Contact:	Mike Bollinger	Beazer Remediation Manager	May 16, 2012	(412) 208-8864
	Name	Title	Date	Phone no.
	Reporting is up-to-date	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Reports are verified by the lead agency	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Specific requirements in deed or decision documents have been met	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Remarks: EPA is in the process of determining the current owner of the Northern Area to insure restrictions in the AOC are still valid ICs with the current owners.				
2.	Adequacy	<input type="checkbox"/> ICs are adequate	<input checked="" type="checkbox"/> ICs are inadequate	<input type="checkbox"/> N/A
Remarks: ICs are adequate on-site. ICs on-site restrict use to non-residential and prohibit the installation of groundwater wells. HGSD rules restrict groundwater use off-site, but do not completely prohibit this. ICs need to be implemented off-site to prohibit access to the contaminated groundwater.				

D. General			
1.	Vandalism/trespassing	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No vandalism evident
Remarks: _____			
2.	Land use changes on site	<input type="checkbox"/> N/A	
Remarks: The Southern Area continues in use as an industrial site and trucking facility. The Northern Area is now vacant.			
3.	Land use changes off site	<input type="checkbox"/> N/A	
Remarks: In the residential area one block immediately west of the Northern Area most of the houses have been removed and the area is now vacant.			

VI. GENERAL SITE CONDITIONS			
A. Roads	<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A	

1.	Roads damaged	✓ Location shown on site map	Γ Roads adequate	Γ N/A
Remarks: The access road east of southwest cap shows some shifting in the road, possibly due to a washout created when a water supply line broke. The cap has not been compromised as a result of this.				

B. Other Site Conditions				
Remarks : Site conditions were generally good.				
VII. SOIL COVERS ✓ Applicable Γ N/A				
A. Landfill Surface				
1.	Settlement (Low spots) Areal extent _____ Depth _____ Remarks: _____	Γ Location shown on site map	✓ Settlement not evident	
2.	Cracks Remarks: An approximately 15 foot long ¼ to ½ inch wide crack exists in the Southeast Cap along the slope at the eastern edge. The crack should be sealed and monitored.	✓ Location shown on site map	Γ Cracking not evident	
3.	Erosion Areal extent _____ Depth _____ Remarks: See above note about suspected wash-out on the access road east of the southwest cap.	Γ Location shown on site map	✓ Erosion not evident	
4.	Holes Areal extent _____ Depth _____ Remarks: _____	Γ Location shown on site map	✓ Holes not evident	
5.	Vegetative Cover Γ Grass Γ Trees/Shrubs (indicate size and locations on a diagram) Remarks:	Γ Cover properly established	Γ No signs of stress	
6.	Alternative Cover (armored rock, concrete, etc.) Remarks: The contaminated soil cover is a reinforced concrete cap. The cap is in good condition.	Γ N/A		
7.	Bulges Areal extent _____ Height _____ Remarks	Γ Location shown on site map	✓ Bulges not evident	

8.	Wet Areas/Water Damage <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade	<input checked="" type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ Remarks: _____
9.	Slope Instability <input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map Areal extent _____ Remarks _____	<input checked="" type="checkbox"/> No evidence of slope instability
B. Benches <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
C. Letdown Channels <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		

4.	Undercutting	<input type="checkbox"/> Evidence of undercutting <input checked="" type="checkbox"/> No evidence of undercutting Remarks: _____
5.	Obstructions Type _____ <input type="checkbox"/> Location shown on site map Areal extent _____ Size _____ Remarks _____	<input checked="" type="checkbox"/> No obstructions
6.	Excessive Vegetative Growth Type _____ <input type="checkbox"/> No evidence of excessive growth <input type="checkbox"/> Vegetation in channels does not obstruct flow <input type="checkbox"/> Location shown on site map Areal extent _____ Remarks: Weeds growing in the caulked joints need to be removed.	
D. Cover Penetrations <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A The storm water inlets in the capped areas are in good condition.		
1.	Monitoring Wells (within surface area of soil cover) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks: _____	
2.	Settlement Monuments <input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <input checked="" type="checkbox"/> N/A Remarks: _____	

E. Gas Collection and Treatment	Γ Applicable	✓ N/A
F. Cover Drainage Layer	Γ Applicable	✓ N/A
G. Detention/Sedimentation Ponds	Γ Applicable	✓ N/A

H. Retaining Walls	Γ Applicable	✓ N/A
I. Perimeter Ditches/Off-Site Discharge	Γ Applicable	✓ N/A
VIII. VERTICAL BARRIER WALLS		
	Γ Applicable	✓ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES		
	✓ Applicable	Γ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines		
✓ Applicable Γ N/A		
The groundwater extraction system and treatment plant were put into operation in September 1995 and operated until April 2006 when the system became inoperative as a result of a suspected lightning strike. These systems are no longer in operation.		
B. Surface Water Collection Structures, Pumps, and Pipelines		
Γ Applicable ✓ N/A		
The storm water collection system in the southeast area is to catch runoff from the paved areas including the capped area. This system is inspected independently as part of the annual inspection and was noted to be in good condition.		

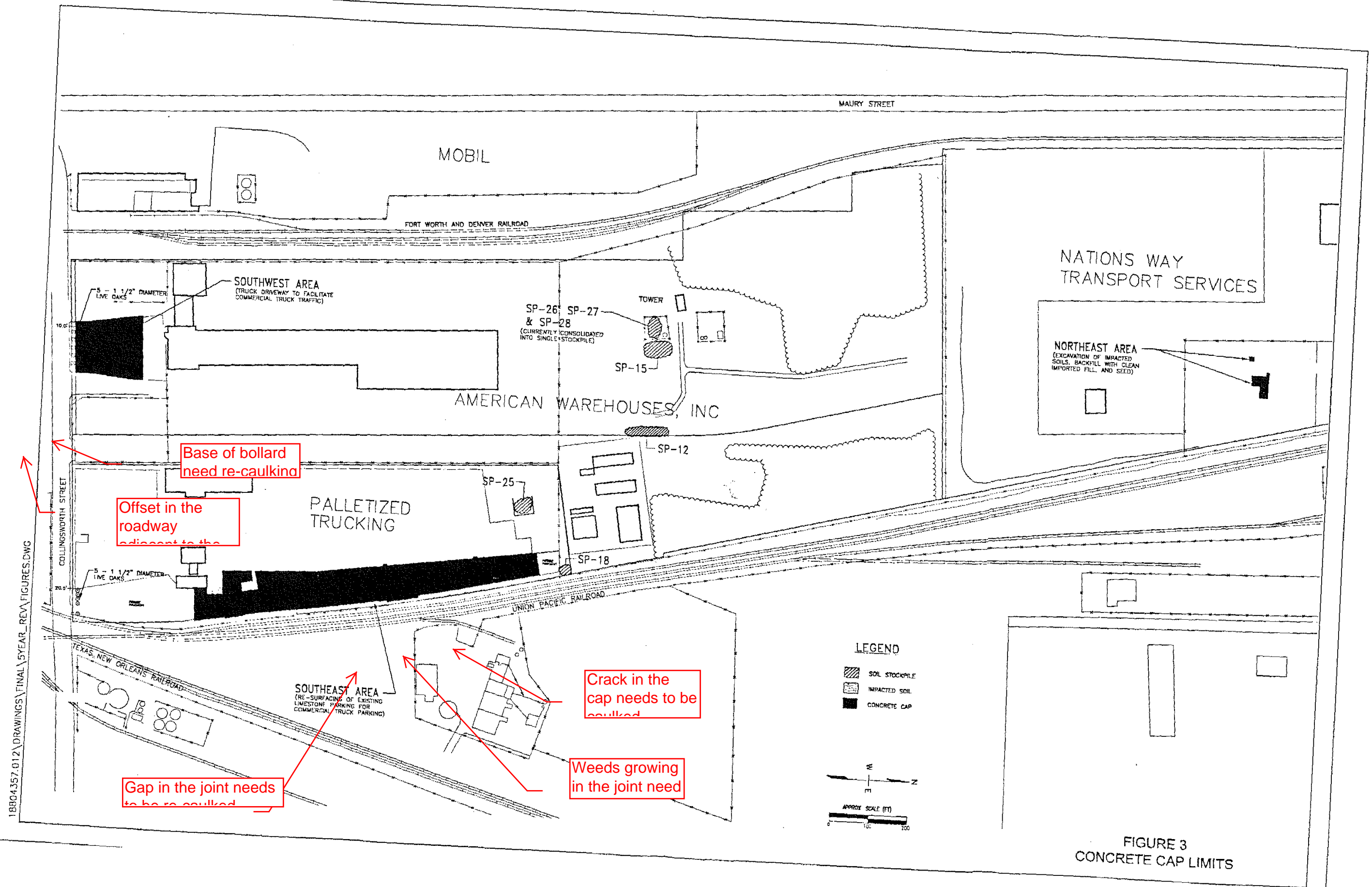
C. Treatment System		
✓ Applicable Γ N/A		
The ground water extraction system and treatment plant were put into operation in September 1995 and operated as intended until April 2006 when the system became inoperative as a result of a lightning related power surge which damaged the system controllers. The groundwater treatment system has not been operated since April 2006.		
D. Monitoring Data		
1.	Monitoring Data	
	Γ Is routinely submitted on time	Γ Is of acceptable quality
Remarks: There is annual groundwater monitoring of the deep aquifer that is being submitted to EPA. There is no established groundwater monitoring plan for the shallow and intermediate aquifers being followed at the Site. The groundwater samples are not being analyzed for all of the groundwater constituents with remedial goals established in the ROD. The most recent sampling results from March 2011 for the shallow and intermediate aquifer have not been submitted to EPA.		

D. Monitored Natural Attenuation

1.	Monitoring Wells (natural attenuation remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input checked="" type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks: The wells in the southern portion of the Site are all flush mount or contained in vaults. The well and the vault covers were found to be in good condition, except that some of the wells were unlabeled or the labels were unreadable. Monitoring wells in northern area have well pads and above ground well casings and protective casings. Wells in the northern area were observed with missing or unreadable labels, missing caps, and damaged well pads. An unlabeled well was found outside of the fenced and secure Site boundaries west of the northern area. The well, which appears to be MW-25, was found to have no locking cover to prevent access to the well cap. The 2006 Supplemental Groundwater Investigation attempted to sample 21 existing monitoring wells and piezometers at the Site. Five wells could not be sampled because four wells could not be located, and one well was damaged. Additionally, deep well LCW-01 has not been sampled since 1996 due to an obstruction in the well. A complete inspection of all the wells at the Site should be conducted to identify problems with the wells. Wells should be labeled, with caps on the well casing and locking covers on the protective casing, and damaged well pads should be replaced. Damaged and un-restorable wells should be evaluated for usefulness, and should either be plugged and abandoned or replaced.
X. OTHER REMEDIES	
Not applicable.	
XI. OVERALL OBSERVATIONS	
A.	Implementation of the Remedy
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The soil remedy, a concrete cap in over two areas of contaminated soil (southeast and southwest) was constructed to serve as truck parking, but it effectively provides a barrier to contaminated soils and eliminates surface infiltration to ground water. The remedy is effective and functioning as designed. The ground water extraction system and treatment plant were put into operation in September 1995 and operated until April 2006 when the system became inoperative as a result of a suspected lightning strike. The monitoring component and extraction system to minimize off-site migration has been suspended pending re-evaluation of the remedial approach and goals. Monitored Natural Attenuation is being considered as one of the alternative remedial actions for the site and a Focused Feasibility Study is under review.	
B.	Adequacy of O&M
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M procedures are in place and ensuring that contaminated soils will be contained for long-term Protection. The Site is fenced and secure. The groundwater well system at the site needs maintenance.	

C.	Early Indicators of Potential Remedy Problems
	<p>Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.</p> <p>There are no early indications that the groundwater collection and treatment system or the concrete cap will fail or compromise protectiveness of the remedy in future. However, as mentioned above, a re-evaluation of the groundwater remedy is under review.</p>
D.	Opportunities for Optimization
	<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p>Jim Zubrow, the principal hydrogeologist and project manager for Beazer's technical consultant (Key Environmental, Inc.), suggested that O&M at the Site could be optimized by reducing the frequency of the O&M visits without any adverse consequences.</p>

18804357.012\DRAWINGS\FINAL\5YEAR_REV\FIGURES.DWG



Attachment 4
Site Inspection Photographs



Photo 1. Southern area. Looking northwest at the southwest cap from the southeast corner. The cap is in good condition.



Photo 2. Southern area. Looking east along the northern edge of the southwest cap.



Photo 3. Southern area. Manhole cover at the northeast corner of the southwest cap.



Photo 4. Southern area. The base of the bollard at the manhole cover needs to be re-caulked.



Photo 5. Southern area. Typical joint caulking in the southwest cap.



Photo 6. Southern area. Well labeled 11, typical monitoring well cover west of the southwest cap.



Photo 6. Southern area. Unlabeled well near MW-11 west of the southwest cap.



Photo 7. Southern area. Well OW19 west of the southwest cap.



Photo 8. Southern area. Driveway just east of the southwest cap with an offset at the joint.



Photo 9. Southern area. Offset in the driveway along the joint just north of Photo 8.



Photo 10. Southern area. Vault covers for recovery well RWS-2 and mechanical, and wells RWS-3, -4, -6.



Photo 11. Southern area. Looking north from the south edge of the southeast cap. The cap is in good condition.



Photo 12. Southern area. Weeds growing out of the caulked joint near the east edge of the southeast cap, at the southeast corner of the building in the cap.



Photo 13. Southern area. A new building was built on top of the southeast cap in 2009.



Photo 14. Southern area. Looking north along the western edge of the southeast cap, north of the buildings



Photo 15. Southern area. Looking south along the east edge from the northeast corner of the southeast cap.



Photo 16. Southern area. Crack near the east edge of the southeast cap.



Photo 17. Southern area. Weeds growing out of the caulked joint along the east edge of the southeast cap.



Photo 18. Southern area. Water stands in the ditch along the east edge of the southeast cap.



Photo 19. Southern area. Along the east edge of the southeast cap, a joint with a gap in the caulking that needs to re-caulked.



Photo 20. Northern area. Well OW2.



Photo 21. Northern area. Unlabeled well north of OW2.



Photo 22. Northern area. Vault for well RWN-4



Photo 23. Northern area. Two adjacent wells, one unlabeled, one labeled PTZ-2. South of RWN-4.



Photo 24. Northern area. Unlabeled well adjacent to well labeled PTZ-2 is missing the well casing cap.



Photo 25. Northern area. Well OW-15.



Photo 26. Northern area. Well OW-15 is missing the well casing cap.



Photo 27. Northern area. Well OW-16.



Photo 27. Northern area. The well pad for OW-16 is damaged and needs to be replaced.



Photo 28. Off-site west of northern area. Unlabeled well in the area of MW-25.



Photo 29. Off-site west of northern area. Unlabeled well in the area of MW-25 is missing the cover for the protective casing.

Attachment 5
Public Notice

AFFIDAVIT OF PUBLICATION

STATE OF TEXAS:

COUNTY OF HARRIS:

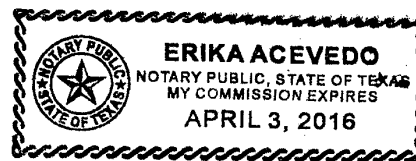
Before me, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared, the Newspaper Representative at the HOUSTON CHRONICLE, a daily newspaper published in Harris County, Texas, and generally circulated in the Counties of: HARRIS, TRINITY, WALKER, GRIMES, POLK, SAN JACINTO, WASHINGTON, MONTGOMERY, LIBERTY, AUSTIN, WALLER, CHAMBERS, COLORADO, BRAZORIA, FORT BEND, GALVESTON, WHARTON, JACKSON, and MATAGORDA and that the publication, of which the annexed herein, or attached to, is a true and correct copy, was published to-wit:


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Notary Public in and for the State of Texas

South Cavalcade Street Superfund Site
PUBLIC NOTICE

U.S. EPA Region 6 Begins Third Five-Year Review of Site
Remedy



The U.S. Environmental Protection Agency Region 6 (EPA) is conducting the third five-year review of the remedy for the South Cavalcade Street Superfund Site in the City of Houston, Harris County, Texas. The review will evaluate if the remedy continues to protect public health and the environment.

The South Cavalcade Superfund Site occupies approximately 66 acres of land located approximately three miles north of downtown Houston, Texas, and about one mile southwest of the intersection of Interstate Loop 610 and U.S. Highway 59. The Site is bounded by Cavalcade Street to the north, Collingsworth Street to the south, and the Missouri and Pacific Railroads to the east and west. The Site is the former location of a wood treating plant that operated from 1910 until 1962 and a coal tar distillation plant that operated from about 1944 to 1962.

The third five-year review is scheduled to be completed in September 2012. Results of the third five-year review will be made available to the public at the following information repository:

Houston Central Library
Government Documents Area
500 McKinney Street
Houston, Texas 77002

Questions concerning the South Cavalcade Street Superfund Site should be directed to Raji Josiam at (214) 665-8529 or 1-800-533-3508 (toll free), or by email at Josiam.Raji@epamail.epa.gov.